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THE GILEPPE RIVER DAM NEAR VERVIERS, BELGIUM.

THE object of damming the Gileppe was to constitute a storage basin for supplying the city of Verviers, ten kilometers distant, with water.

Verviers is a city that has a population of 38,000 inhabitants, who are occupied in great part in the manufacture of cloths and other fabrics. Its commercial activity is considerable, and its manufactures are yearly increasing in importance. Although situated upon the river Vesdre, from which it formerly derived the greater part of the water that it required, the city had long suffered from an insufficient supply, especially of pure water. For, in measure as the cloth industry increased, the waters of the Vesdre above the city became more and more foul from the washings of wool in the yolk. The river, in addition, furnished at certain seasons a supply that was entirely inadequate to the wants of the population.

In order to remedy this state of things it was decided, then, to have recourse to an artificial supply, and Engineer-in-chief Bidaut therefore studied between 1857 and 1859 a special project. It was at first proposed to construct an immense basin in the valley of the Vesdre, but, opposition having been made by the city of Eupen, which is located on the same stream, it was finally decided to utilize the valley of some one of its affluents. Of all these latter, the Gileppe was at length decided to be the most suitable. In the selection of the valley of this tributary, not only was there taken into account the quantity of water that would be needed by the city, but also the local conditions upon which the construction of the reservoir would depend.

Generally speaking, it is necessary, for such purposes, that the bottom of a valley shall be impermeable. A stratum of clay 15 meters thick may be considered as sufficient, inasmuch as its thickness will always go on increasing in consequence of deposits. The valley must present a certain width, with a contraction at the spot where the dam is to be located; and the grade of the bottom should be slight at the beginning and heavy at a certain distance. The banks should rise rapidly in order that, with a relatively small extension, the greatest quantity of water possible may be stored.

The point where the foundation wall is to be built must present an incompressible soil at a slight depth, and must have in its vicinity the materials for construction, and permit of their easy carriage to the spot where they are to be used.

Now all these conditions are found united in the valley of the Gileppe, and it was consequently decided to locate the dam therein.

Having thus fixed upon the proper valley, it remained to examine whether it would be better to construct a single reservoir of 12,000,000 cubic meters or to break such capacity up into basins of more modest dimensions. Such a choice depends upon topographical conditions that permit at certain points of obtaining, with a dam of a certain height, a greater capacity than could be done elsewhere with one of double the height. As we have already said, the most proper points are those where the valley offers a narrow gorge which keeps increasing up stream in the form of a funnel. A dam placed at the narrowest point of the gorge permits of collecting, with a work of the least length possible, the enormous quantity of water that falls into the funnel. Under such circumstances it is generally preferable to construct a single reservoir, although, for an equal capacity, other solutions may sometimes be more economical. Let us remark that in the case of multiple reservoirs, each of them has very respectable dimensions, and the water stored up in them is large in quantity. And with such reservoirs the chances of their giving way likewise multiply. Besides, if one of the upper breaks away, it is to be feared that the mass of water let loose will carry with it the successive ones, breaking away the walls below. Then again, it should be observed that points are not easily met with that are adapted for the erection of several dams.

From an examination of the different projects presented by Mr Bidaut, it resulted that the price of the reservoirs per cubic meter of the capacity in-

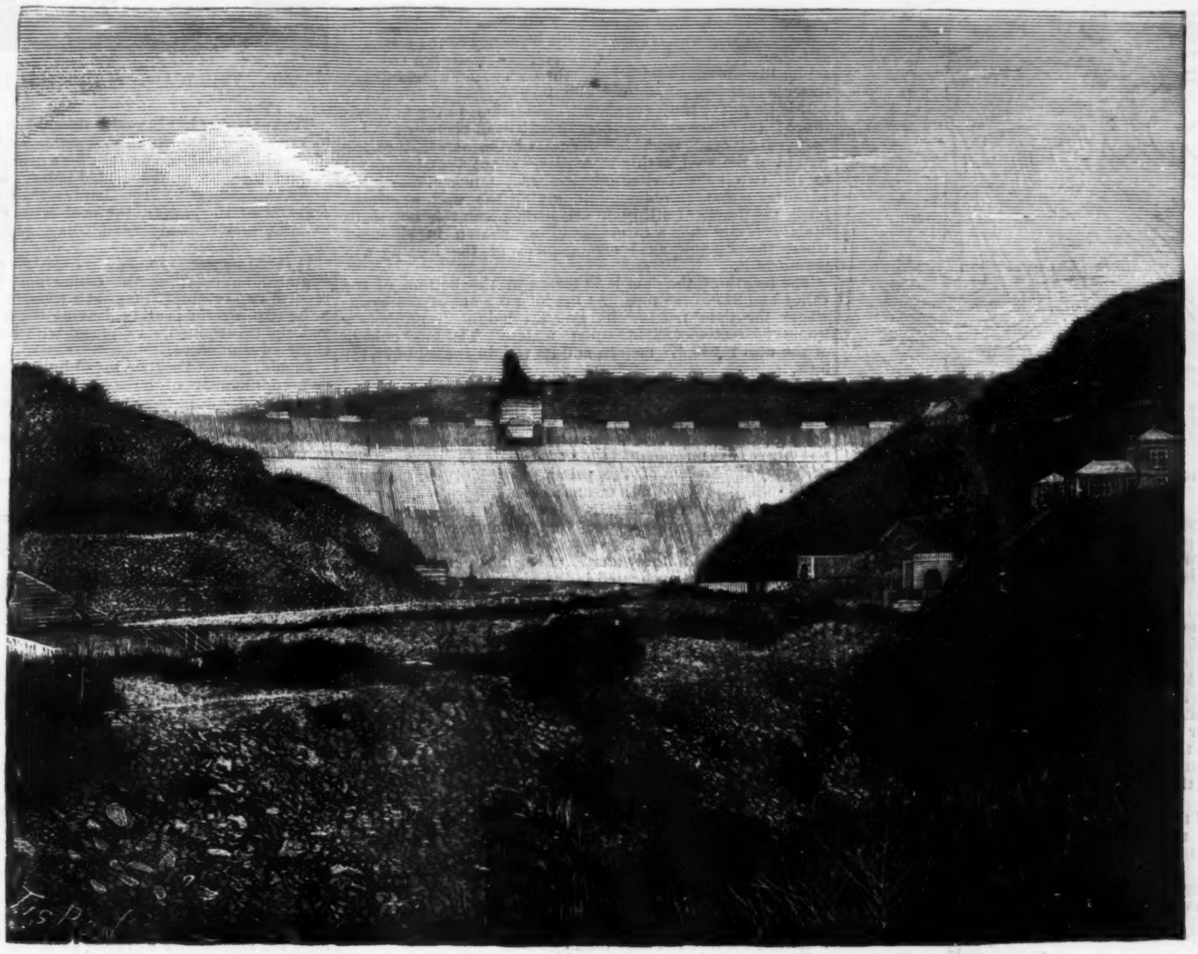


FIG. 1.—THE GILEPPE RIVER DAM.—GENERAL VIEW.

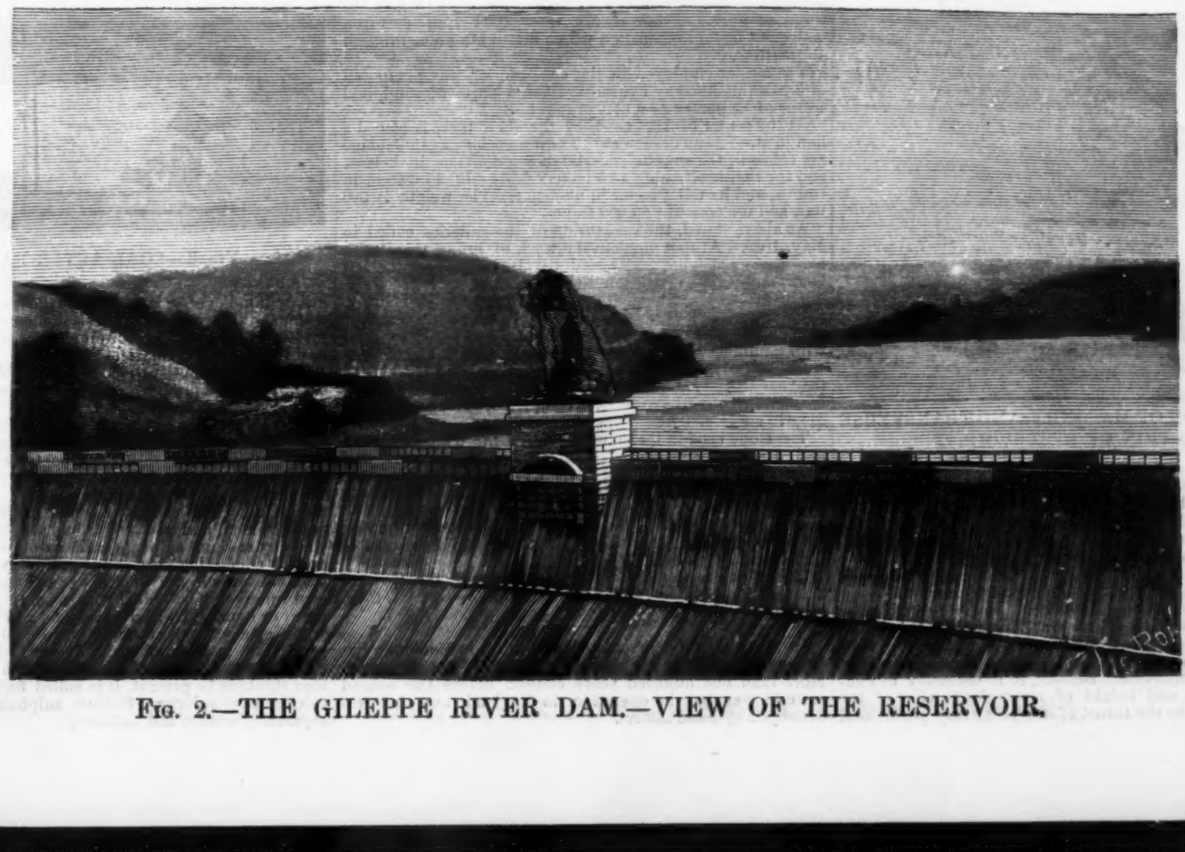


FIG. 2.—THE GILEPPE RIVER DAM.—VIEW OF THE RESERVOIR.

creased rapidly in measure as the retaining walls diminished in height.

Thus, with a dam 45 meters in height, we obtain a basin cubing twelve millions of meters, while in employing walls of 29 meters it requires four basins to obtain the same capacity. As it was difficult to find points for the construction of four such dams, it was decided to construct only one 45 meters in height.

A spot adapted for the building of the dam was met at about 1,500 meters in ascending the Gileppe from the Vesdre. In fact, the valley possessed at this point a contraction along an extent of about 600 meters, and above this a considerable width. Another advantage presented by the arrangement of the locality was that it was possible to place the dam at right angles to the two banks, and parallel with the stratification of the rocks, so that the strata would not have to be cut obliquely.

As has been stated, the height of the dam was fixed at 45 meters. The surface corresponding to such a height is 800,500 square meters, and the capacity is 12,238,916 cubic

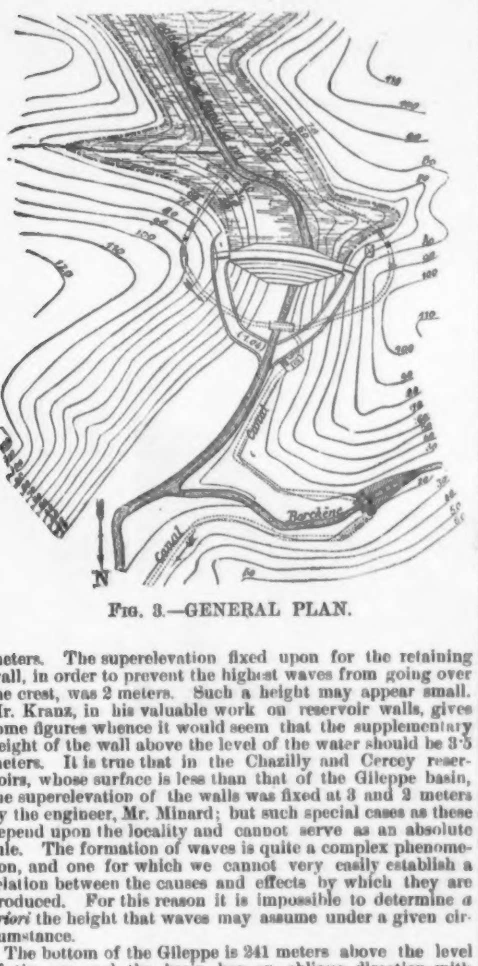


FIG. 3.—GENERAL PLAN.

meters. The superelevation fixed upon for the retaining wall, in order to prevent the highest waves from going over the crest, was 2 meters. Such a height may appear small. Mr. Kranz, in his valuable work on reservoir walls, gives some figures whence it would seem that the supplementary height of the wall above the level of the water should be 3·5 meters. It is true that in the Chazilly and Cercey reservoirs, whose surface is less than that of the Gileppe basin, the superelevation of the walls was fixed at 3 and 2 meters by the engineer, Mr. Minard; but such special cases as these depend upon the locality and cannot serve as an absolute rule. The formation of waves is quite a complex phenomenon, and one for which we cannot very easily establish a relation between the causes and effects by which they are produced. For this reason it is impossible to determine *a priori* the height that waves may assume under a given circumstance.

The bottom of the Gileppe is 241 meters above the level of the sea, and the basin has an oblique direction with respect to the northwest line, as may be seen from the annexed sketch (Fig. 3). The result is that the highest waves that can form break against the sides of the embankment. It should be observed here that the two water courses, the

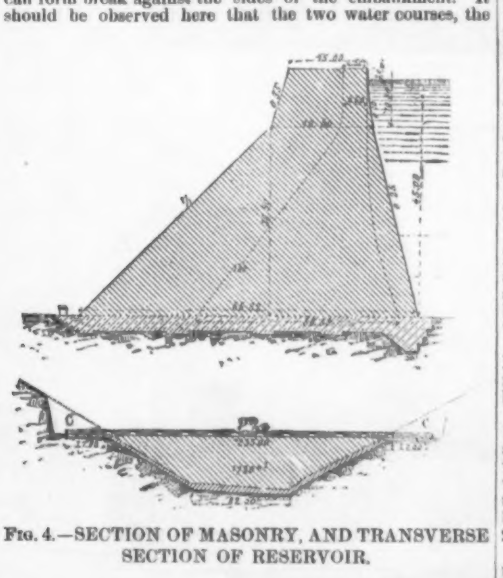


FIG. 4.—SECTION OF MASONRY, AND TRANSVERSE SECTION OF RESERVOIR.

Hoëque and Eupen, which empty into the Gileppe, might in certain cases bring about a sudden rising of the water that would exceed the level of the wall and flow over it like a gigantic cascade. It appears to us, then, that the superelevation given the wall is not enough.

The width of the wall at the crest cannot be determined simply by a calculation of the static conditions of the dam, for the dimensions become smaller and smaller toward the summit and are reduced to zero at the crest. It is necessary, then, to take into account the depth of the reservoir, since in certain cases the shock of the waves may reach an extraordinary proportion. Besides, it is necessary to consider the length and height of reservoirs in view of the formation of ice, as the thrust of the latter may prove fatal to the wall, particularly when a sudden thaw occurs and the wind blows with violence.

This is why the width of the crest was fixed at 15 meters. As for the base, the extraordinary thickness of 65·5 meters was given it (Fig. 4). In this figure the dotted lines represent the profile of the wall such as it would have been constructed according to the calculations of Mr. Crugnola, and renders more perceptible the enormous disproportion between the two projects.

Mr. Bidaut, the engineer-in chief, believes that the enormous dimensions given by him to the Gileppe dam are justified by the following considerations:

1. As the capacity of the reservoir exceeds 12 millions of cubic meters and may reach 14 millions, the consequences of its giving way would be infinitely more grave than would those of the Furens dam, which is only 49·08 meters thick at the base.

2. The length of the wall is 235 meters, that is to say, 135 meters longer than that of the Furens dam, and Mr. Bidaut believes that the dimensions of the walls should increase proportionally to their length.

3. As the dam was the first that was built in Belgium, the engineer judged it absolutely necessary not to risk the least chance of any accident that would set the public against this kind of construction.

4. Finally, the dam should be able, in addition, to resist a sudden shock that might be produced by an unexpected rising of the waters of the Hoeque and Eupen.

The general form of the dam is that of an arc of a circle of 500 meters radius, and the convexity of which faces up stream. This form is the one that presents the greatest resistance, as much on account of the elasticity of the masonry as because of the property that a curved wall possesses of acting like an arch against the thrust of the water, seeing the cohesion of a good hydraulic lime.

It is proper to observe that a transmission, to the extremities, of the stresses supported by the wall occurs only for such as proceed from the thrust of the water, since the weight of the wall, acting vertically, cannot be transmitted to the two ends. Although this fact much reduces the advantage that is obtained in giving the wall a curved form, the practical utility of the arrangement is not to be disdained, and such a form should be chosen in all cases where the topographical arrangement of the locality will permit of it.

The length of the dam is 82 meters at the bottom of the valley and 245 at the top. At the lowest point of the basin, where the dam reaches its greatest height, it presents a transverse section of 1,738 square meters. The total cubage of the wall is 248,470 meters, and its weight is about 571,481 tons.

The height of the highest level of the water above the bottom of the valley is 45 meters, and in order that it may not exceed that, two weirs, each 27 meters in length, have been formed in the rock at the two extremities of the dam, and these, by means of two converging canals, lead the waters to the bottom of the primitive bed of the Gileppe. As the dam serves also as a means of communication between the two declivities of the valley, these weirs are crossed by metallic bridges, of three spans of 9 meters each, united to the lateral roads.

The discharge of the water is effected through two subterranean galleries excavated in the sides of the adjoining mountains, in imitation of the drainage canal of the Furens dam. This arrangement is certainly the best, in that, being external to the dam, it avoids any break in the masonry. These two galleries traverse the mountain at a distance of 100 meters from the masonry. It was thought best to have two, so as to be always able to utilize one in case the other had to be repaired. Each of them is 2·7 meters in height and 2·4 meters in width. They are both lined with masonry and project into the basin at the points A and E by means of conduits protected by a grating. These conduits are prolonged to the lowest point of the basin so as to permit of completely draining it.

The galleries were constructed between 1867 and 1869, and served during the entire work on the dam for carrying off all the water of the Gileppe. The maximum discharge was 20 cubic meters per second. In each gallery there are arranged pipes designed for distributing water throughout the city of Verviers. Both terminate in a small basin below, whence starts a masonry canal, 2 meters in width, having vertical walls, and being arched at the top so as to have a height of 2·5 meters under the keystone.

The canal follows the left bank of the Gileppe, and then that of the Vesdre, for a distance of 9 kilometers. Near the city of Verviers there is a reservoir located at a height of 85 meters above the mean level of the city, and into which the canal empties. From thence there start four cast-iron mains, 0·6 meter in diameter, which distribute water through all quarters.

The mortar employed in the construction was composed of 5 parts of Tounay hydraulic lime, 4 parts of sand, and 1 part of Rhine *trass*—a sort of pozzuolana.

At the center of the crest of the dam there is placed a lion in stone as an ornament. The dimensions of this image are colossal, the granite pedestal being 8 meters in height, and the lion itself being 13·5 meters in height, 16 meters in length, and its tail 1 meter in diameter. The weight is 300 tons and the cost was 80,000 francs.

As above stated, the excavating of the galleries ended in May, 1869. At that moment the work of lining them with masonry was begun, and lasted till July, 1870, on the left bank, and till May, 1871, on the right.

The masonry of the dam was begun on the 21st of July, 1870, and on the 22d of October of the same year was already 12 meters above the bottom of the valley. In 1871, with a number of masons, varying between 80 and 100, at work, 60,000 cubic meters were constructed; at the end of the year 1872, 172,860 had been constructed; and in November, 1875, the entire work was completed, giving a total of 248,470 cubic meters.

The stone used in the construction of the dam was quarried at a point near the confluence of the Vesdre and Gileppe, upon the left bank of the latter, and was carried to the works by a small narrow gauge railroad, whence ran a branch 5 kilometers in length to Dolhain for the lime and trass. A 40-horse power steam engine was used for mixing the mortar, which latter was afterward raised by means of three inclined planes.

The work was executed at the expense of the Government, and its total cost was 4,549,000 francs.—*Le Génie Civil.*

IN 1663 a Dutchman erected a sawmill in England, but the hostility of the workmen compelled its abandonment. More than one hundred years elapsed before the second sawmill was put in operation in England, and that was destroyed by hand-sawers.

LIME INSTEAD OF POWDER FOR MINING.

THE method of mining by making use of the expansive force realized when quicklime and water are brought together, is now employed at the Eureka colliery of Messrs. Berwind, White & Co., in the Clearfield District of Pennsylvania. The illustrations given herewith show the general method of operating.

Fig. 1 shows the application of the drilling machine.

Fig. 2 shows the application of the pump after the hole is charged and stemmed.

Fig. 3 shows the coal after it has fallen—getting out larger lumps than usual.

The time occupied in drilling a hole 3 feet deep and 2¾ inches in diameter, including setting up the drill, averages 12 minutes; charging a hole with cartridges and tamping up, 4 minutes; and pumping in the water, 1 minute; thus effecting a considerable saving of time as compared with drilling, charging, and tamping a hole for gunpowder.

FIG. 1.—APPLICATION OF DRILLING MACHINE.

The sprags are left in under the coal so as to allow the force to exert itself as far back as possible, and in many instances the coal is forced off and falls for a distance of several inches behind the end of the drilled holes. In from 10 to 30 minutes, according to the hardness of the seam, on the removal of the sprags, the coal falls clean from the roof in large masses ready for loading, particularly making no small.

If the sprags are removed at once, the entire length of coal operated on falls; but the collier can, if more convenient, remove two or three sprags at a time, and let down as much as he requires for loading, leaving the rest to remain spragged up till wanted. In places with bad roofs this is especially advantageous.

In addition to the time saved by this process, and the increased quantity of large coal that can be got in fewer hours' work, it is hardly possible to describe to those who have not witnessed it, the saving of laborious exertion to the collier himself compared with what he has to go through in wedging.

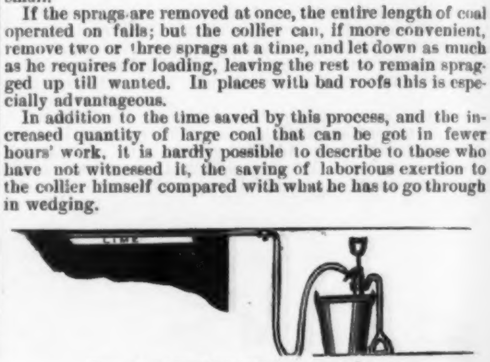


FIG. 2.—APPLICATION OF PUMP.

The following are among the principal advantages claimed for this system:

Absolute immunity from explosion of gas, there being no fire or flame.

There is no smoke or noxious smell of any kind.

The roof is not shaken by this process; no vacuum is created, as is the case with a blown out shot; and the coals in falling produce much less dust, thereby reducing the danger which is generally admitted to arise from the air of a mine being heavily charged with small particles of coal.

Skilled labor is unnecessary, and the coal can be got with much less exertion to the collier than by wedging.

The apparatus is simple and inexpensive; it is easily carried about and kept in order; and it can be used in narrow and cramped workings, and in thin seams.

After pumping the water into the charged holes the men need not discontinue working, as is the case with gunpowder, for by simply moving away from the face of the coal while the sprags are being taken out, all risk of injury from falls is avoided.

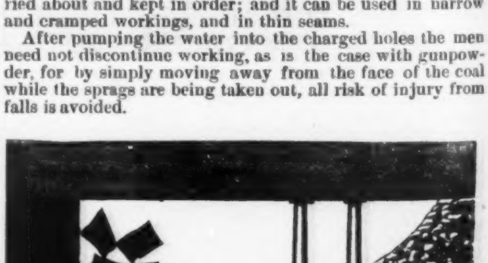


FIG. 3.—COAL AFTER FALLING.

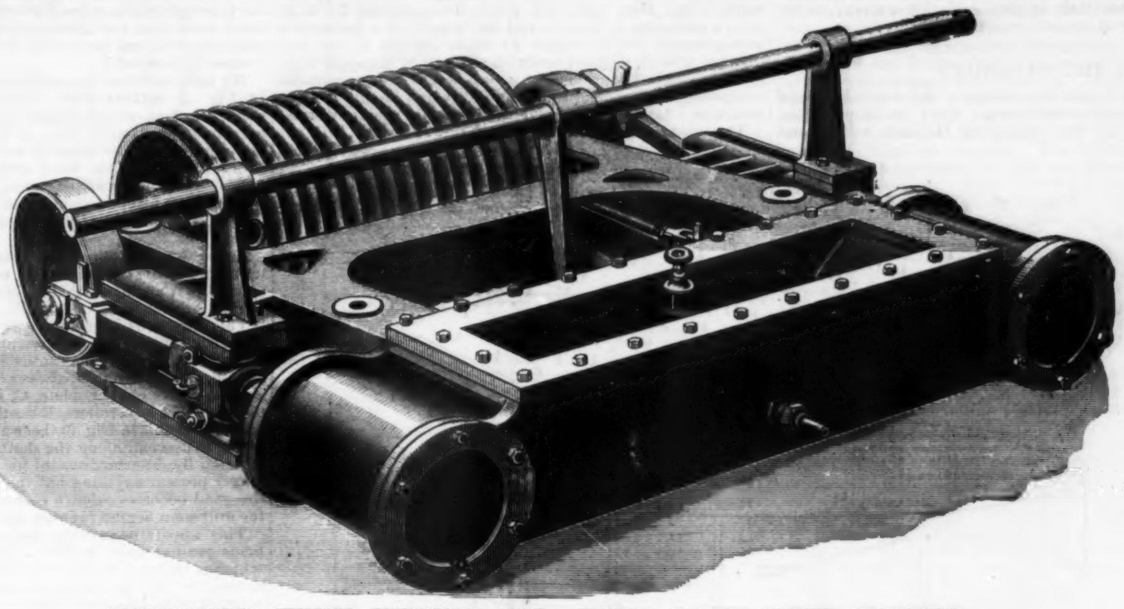
Any number of holes can be loaded, and by applying the water to them in quick succession a continuous and gradual pressure is brought to bear along the face, which causes the coal to fall in large masses.

The larger quantity of coal brought down and its better condition have brought forth many encomiums.

LEAD FUMES.—A process for working lead fume into litharge and red lead is described in the *Journal* of the Society of Chemical Industry. The fumes from the working of galena contain lead sulphate, sulphite and oxide, arsenic and antimony, lead sulphide, and when zinc ores are present zinc oxide. The lead fume is mixed with sodium carbonate or hydroxide, and roasted. The product is then washed, whereby sodium sulphate and sulphite and sodium compounds containing arsenic and antimony are separated. The lead compounds are thus converted into lead oxide. The lead fume may be boiled with a solution of sodium carbonate or hydroxide, lead carbonate and hydroxide forming, while arsenic and antimony are dissolved. The washed precipitate is then roasted. In the presence of zinc compound they are removed by boiling with sulphuric acid. If lead sulphide be present, it is boiled first with a solution of calcium hypochlorite. Sodium sulphate is recovered after separating arsenic and antimony.

THE ALLIS TWIN ENGINES.

THE accompanying engraving illustrates an improved style of twin engines for rope feed for saw-mill carriages, made by Edward P. Allis & Co., of Milwaukee, Wisconsin.



IMPROVED TWIN ENGINE FOR WIRE ROPE FEED WORKS.

The cylinders are 10 inches in diameter, by 12 inches stroke. The spool is 24 inches in diameter, 36 inches on the face, is grooved for a two-inch rope, and will run the carriage a distance of 90 feet. The crank shaft is 4¾ inches in diameter. The sawyer's valve is a perfect balance, the steam having no action to bind it in any way, or to move it, or prevent it from moving. The rock shaft can be set either to the right or left to suit either a right or left hand carriage. One wrought iron arm connects the rock shaft and sawyer's valve, and another wrought iron arm, or lever, not shown in the engraving, is attached to the end of the rock shaft, and in line with the sawyer's lever. The stand for the latter is bolted to the floor, the lower part passing below the floor timbers, and having two sheaves at its lower end. A small rope with a weight hung to it passes between these sheaves, and connects with the lower end of the sawyer's lever. Should the sawyer, through carelessness or for other reason, let go of the lever while the engines are in motion, this weight will bring the valve to the center, and cut the steam off from both cylinders. The lever stand also extends about two feet above the floor, and has a guard on either side to prevent the lever from being thrown over too far in either direction, and from giving too much movement to the valve. For further security, when the sawyer leaves his position, there is a lock or fork connected with the top of the lever stand, which is turned over against the lever, making it impossible to start the engines by accident, or until the lock is turned back again, away from the lever.

The connecting rod between the lower end of the sawyer's lever and the arm on the rock shaft can be made of any length to suit the location of the engines. These engines are designed to be set nearly horizontal, the center of the spool being from eight to ten inches higher than the center of the cylinders. From the above description, an idea can be formed of the completeness and general excellence of these engines. For long logs, or where long and short logs are mixed, the advantages this style offers will be apparent to practical mill men. Where there is a long timber carriage, in two sections, the rope should be attached to the head section, so that in changing from short to long logs, and *vice versa*, all that is necessary is to couple or uncouple the tail section of the carriage, which with this carriage and coupling will not require a minute. Additional information may be had by addressing the manufacturers, as above.

SPHERICAL STEAM ENGINE.

ONE of the most remarkable exhibits at the recent Engineering and Metal Trades Exhibition, London, and one which attracted a great deal of attention, was the "Tower" spherical engine, which is now being introduced by the patentees and manufacturers, Messrs. Heenan and Froude, Newton Heath Iron Works, Manchester, and which was shown in operation driving an Edison dynamo. It is, says the *Engineer*, a rotary engine of entirely novel character, and, as the name almost implies, it consists of a sphere of cast iron truly bored out, forming a chamber, within which the steam acts on suitably arranged pistons, the power being taken off by a shaft revolving through a stuffing box in the ordinary way. Several illustrations of this engine are given above. The following is a description of the working parts: The piston shown in Figs. 4 and 5 is a disk or steel having four phosphor-bronze bearings inserted in four recesses, one pair of these, B B, being on one side of the piston, at right angles to the other pair, C C, which are at the opposite side. Referring to Fig. 1, it will be seen that there are two shafts placed in the same horizontal plane but not in the same vertical plane, one the driving shaft and the other the dummy shaft, the latter revolving in bearings within the casing, and being inserted merely for giving the necessary movement to the piston. On the end of each shaft is a blade, Figs. 2 and 3, these being of wedge shape, convex toward the shaft, and having on their faces turned gudgeons or trunnions, which fit into the bearings, B B and C C, on the piston. When the blades and piston are thus coupled together the interior movement is complete, and it may be described as a universal joint with solid matter built up round it so as to form, when revolving, four expanding and contracting chambers. The angle of the shafts is best chosen at 135 deg. In revolving from the position shown in Fig. 1, the area, D E, which constitutes one chamber and is shown fully open, closes, F G opens, that on the further side of F G closes, and N, which is now closed by contact between the blade and piston, opens. Steam is admitted to the chambers when they require to expand, and released when they require to contract, and this is accomplished in the following manner: Two cylindrical excrescences, K and L, are formed on the sphere, and each contains a cylinder—not shown on engravings—having on the face toward the sphere openings or ports for the ingress and egress of steam—see Figs. 6 and 7—and also having around the circumference other openings or ports corresponding with openings formed in the cylindrical shells, communicating by steamways with the supply and exhaust. M, Figs. 1, 2, and 3, are notches in the sides of the blades, arranged so that when a blade revolves, a notch comes over the steam port and admits the steam, which is then cut off by a further movement and allowed to expand, while the notch travels between the inlet and outlet ports. A still further movement brings the notch in communication with the exhaust port, and permits the steam to escape when the chamber is contracting.

The engine at the Exhibition worked well and silently, there being no vibration whatever. The power given out is very great in proportion to the weight of material employed, a 7 in. engine indicating no less than 18-horse power at 600

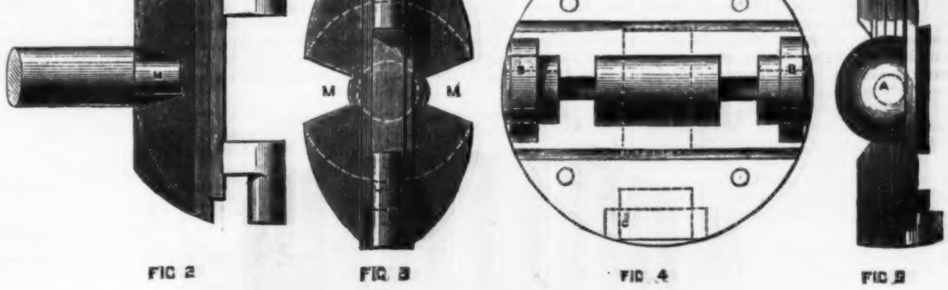
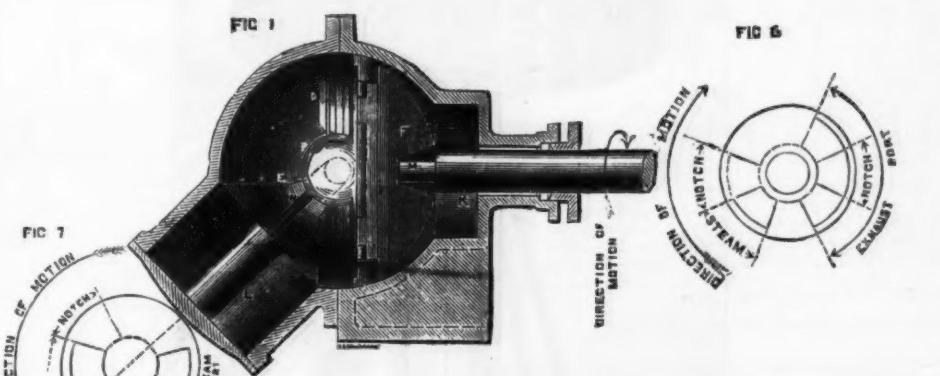
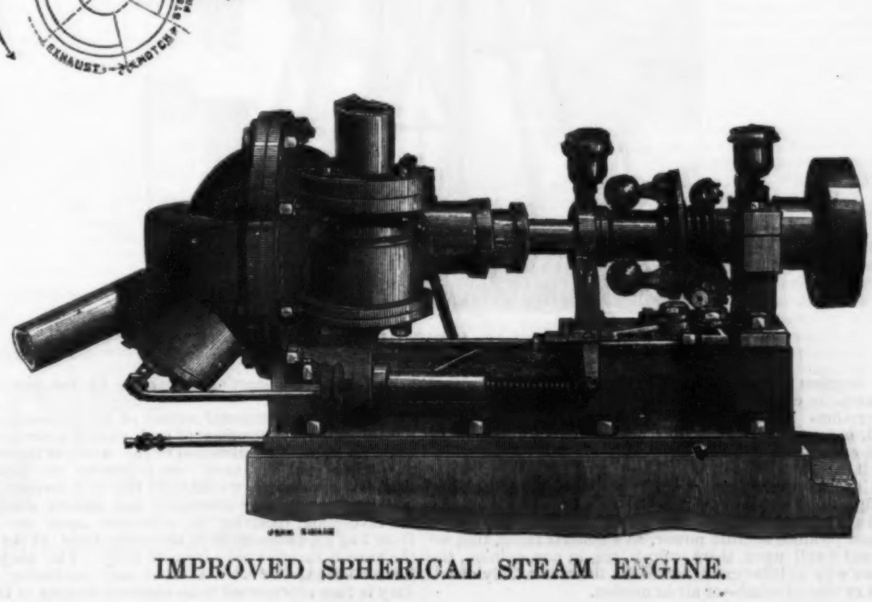


FIG 2 FIG 3 FIG 4 FIG 5





IMPROVED SPHERICAL STEAM ENGINE.

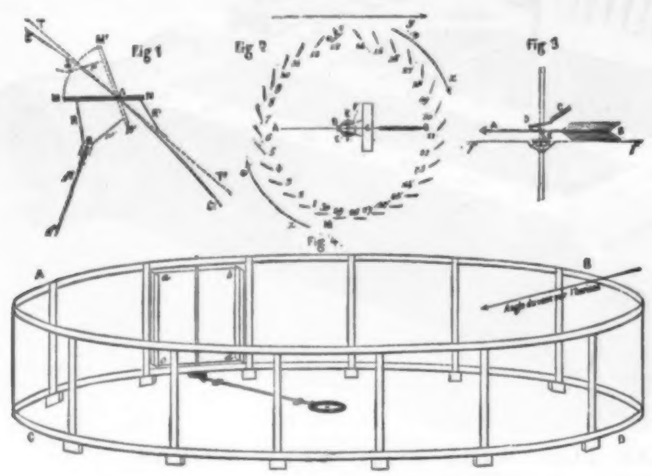
revolutions per minute, with steam at 80 lb. pressure. This, coupled with the fact that the makers guarantee a very considerable saving in steam compared with other rotary engines, will no doubt recommend the "Tower" engine for use in a great number of cases where an ordinary engine could not be conveniently applied, such, for instance, as for the direct driving of dynamo machines.

THE PANEMONE.

OF all natural forces that which is the least costly and the most equally distributed—the wind—is likewise the most neglected. In fact, outside of Holland, we find but rare applications of it. Why is this force so little employed? Would it not be possible and advantageous to utilize it in a large number of cases? Such are the questions that we have proposed to ourselves, and that we have endeavored to solve in inspiring ourselves with theory, with an attentive examination of existing types, and with the observations of practical men. To the first question we respond as follows: (1) The old, classic types, with house upon a pivot, would prove at present impracticable of construction because of the cost of the enormous pieces of wood that compose them. (2) Such motors absorb much force through friction; horizontal shafts, of wood, 0·5 m., 0·6 m., or more in diameter, revolving on bearings of the same nature, under a heavy load, are true brakes. (3) It is very difficult to trim them, and it often requires the power of a horse to do so. (4) To furl the canvas in case of a tempest is one of the most perilous of operations. (5) The mode in which the wind is received is bad, because the force is split up into two forces, one of which causes the mill to revolve and the other tends to reverse it.

All mills with horizontal shafts are based upon the same principles and present in various degrees the inconveniences noted above. As for those with a vertical axis, they are so rare and produce so little power, as a general thing, that we shall not dwell upon them. Such are, in our opinion, the reasons why so little use is made of a force so widely distributed as that of wind—of air in motion.

It has seemed to us that the readers of *La Nature* might be interested in a description of a new type of mill that we have constructed at Grand-Quevilly, near Rouen, and which presents no analogy with any that are known. The apparatus possesses the following advantages: (1) The axis is vertical and rests upon one point, thus securing for us at once a minimum of friction and the benefit of a permanent arrangement. (2) It utilizes its entire surface in the production of work without strain on any part of the apparatus. (3) It is capable of producing any power whatever without compromising the conditions of solidity and facility of construction. (4) It guards itself automatically against storms. The apparatus is constructed as follows:



FIGS. 1 TO 5.—DIAGRAMS EXPLANATORY OF THE PANEMONE.

A cylindrical frame, capable of revolving upon its vertical axis, carries 30 light wooden vanes, 2 m. x 0·4 m., which pivot upon their respective axes, and each of which is divided through the latter into two rectangles of unequal breadth in the ratio of 1 to 2. In a state of rest these vanes present their edges to the wind, and consequently offer a surface that is almost null. Each vane, M N (Fig. 1), is capable, on pivoting upon its axis, A, of assuming two positions, M N and M' N', which form between them an angle of 70° to the right and left of the tangent, TT', of a circumference, *cc'*, whose center coincides with that of the mill, and which passes to the point, A. The vane is capable of being held at M N and M' N' by the two springs, R R', when they come into contact with the stop, B, which latter is connected with the starting apparatus by the iron wire, *ff'* (Fig. 3).

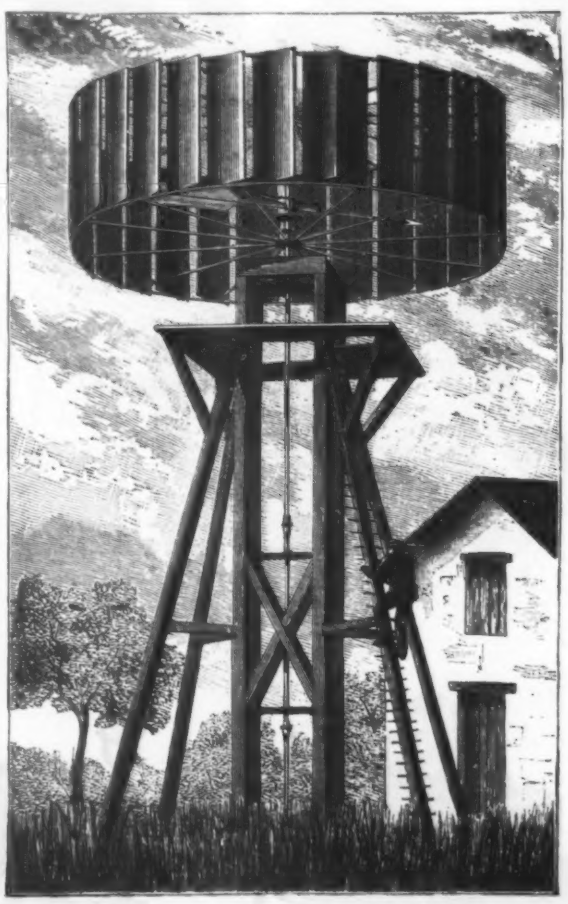


FIG 6.—GENERAL VIEW OF THE PANEMONE.

Fig. 2 gives a horizontal section of the *Panemone*, showing the respective arrangement of each vane at a given moment. Suppose *xy* be the direction of the wind, *es* the direction of rotation, and M a vane; on following the latter for a complete revolution, we shall see that it is keeping the two positions that it takes alternately and *without shock* during the revolution, receiving the wind now upon one surface, from 1 to 13, and now upon the other, from 14 to 25; for the vane is inactive only from 26 to 30. The projection of the surface exposed to the wind and producing effective duty is then represented to an observer looking at the apparatus from a distance, his back to the wind, by the product of the height of the vanes multiplied by $\frac{9}{10}$ of the diameter of the *Panemone*. This large surface is due to the fact that the vanes produce an effective power even on *returning against the wind*, from 14 to 25 and from 1 to 16. This is the principle that is applied in trimming a ship's sails. These latter make with the direction of the wind a variable angle, which may become very small when sailing, as sailors say, "close to the wind."

We have said that the vane changed position from 13 to 14 (Fig. 2) *without shock*. It is well to dwell upon this point. In fact, at the instant during which each vane is occupying position 15, it is, at its part *ab*, protected from the impulsion of the wind by the vane that is occupying the 12th position, and the wind striking it only at *bc*, it opens; but, being at once carried along by the revolution of the *Panemone*, it reaches its new position at the precise instant at which it is completely masked, and consequently without shock.

As for the stops, these are controlled by iron wires that terminate in the center of the mill, at a place where the apparatus is arranged that automatically protects the vanes against squalls.

This apparatus is arranged as follows: A weathercock, A B (Fig. 3), free to revolve upon the shaft of the mill, and which the wind maintains in a fixed direction, carries a plate, C, jointed at D, always opposite the wind. When a storm comes on, this plate, C, is depressed by the force of the wind, the two rollers, E E', that it carries (only one of which is visible in Fig. 3), bear against the socket, F, which is free to descend along the shaft, an ungearing is effected through the intermedium of the wires, *ff*, and the vanes no longer present anything but their edges to the wind. When the wind becomes calm, a contrary motion is produced and the mill soon begins running again.

This apparatus answers the objections that are usually made against such motors. There remains an objection which is inherent to the force itself, and that is its want of constancy; the manufacturer wishes to get to work, but the wind is at a standstill; the agriculturist and the kitchen gardener have more wind than they need before and during rains, but, when ponds are dry, when cereals and vegetables are burning up, there is no wind, no water. The argument is as strong as it is clear, and there is no reply to it. A trial has been made of reservoirs placed at a height, which will, in time, prove useful as storage-places of force, but a second objection has presented itself, and that is, that the motor produces too little to allow or to obtain, through storage, a regular force or a sufficient reserve to supply the mill. The small amount of power, there lies the difficulty. We ought to be able to obtain a considerable force for a mean velocity of the wind. Practice has shown that extremely large mills are not advantageous.

Can we not, however, find some arrangement of the parts that will permit us to proportion in all cases the surface of the motor to the effects to be produced, exactly as is done by the mechanician, who proportions the heating surface to the quantity of steam that he wants to obtain in a unit of time? Can we not construct a multiple mill of unlimited force and power, just as we construct a pile of any number of elements, and totalize upon the same driving shaft their individual force, just as we collect from the same pile a powerful current which is the product of the different elements of the apparatus.

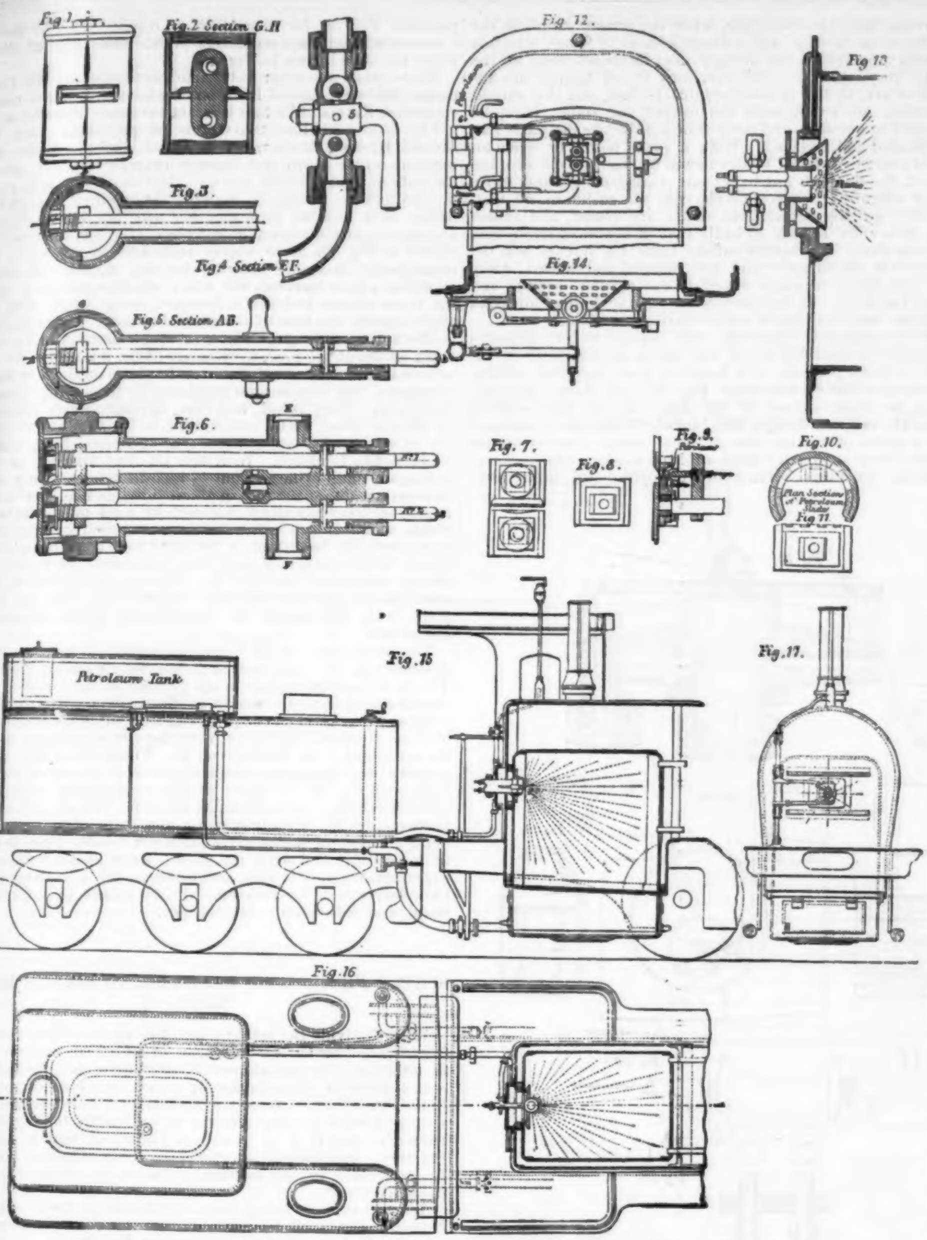
The solution of this problem, which at first sight appears quite simple, would present great difficulties with the mills usually employed, both as regards the transmission of force from one to the other, and the necessity of arranging them so that they shall not shield one another from the wind, whatever be the latter's direction. But these two difficulties disappear of themselves in taking for element the above described *Panemone*, and in giving the multiple mill the following arrangement: Let A B C D (Fig. 4) be a vast circular framework, analogous to that which constitutes the support of gasometers, and in each of the intervals, *a b c d*, formed by the vertical columns, let there be a *panemone element*. It is evident that we may easily totalize in the center of the system the force from all the elements that constitute it, and that we may even establish several stories of like systems or groups of systems, and unite them with each other. We shall remark that this multiple mill as a whole is set in position like one element, and that the wind, making, as well known, an angle of about 15 degrees with the horizon, even acts upon the elements at the back in passing over those that are situated in front.

It appears to us possible, then, to construct wind motors of unlimited force at the present day, for drying vast marshes, for submerging grapevines, for lifting river water into immense reservoirs upon our hills, and for distributing fertility regularly to our lands, and water, force, and light to our cities.—*Lequesne and Lefebvre, in La Nature.*

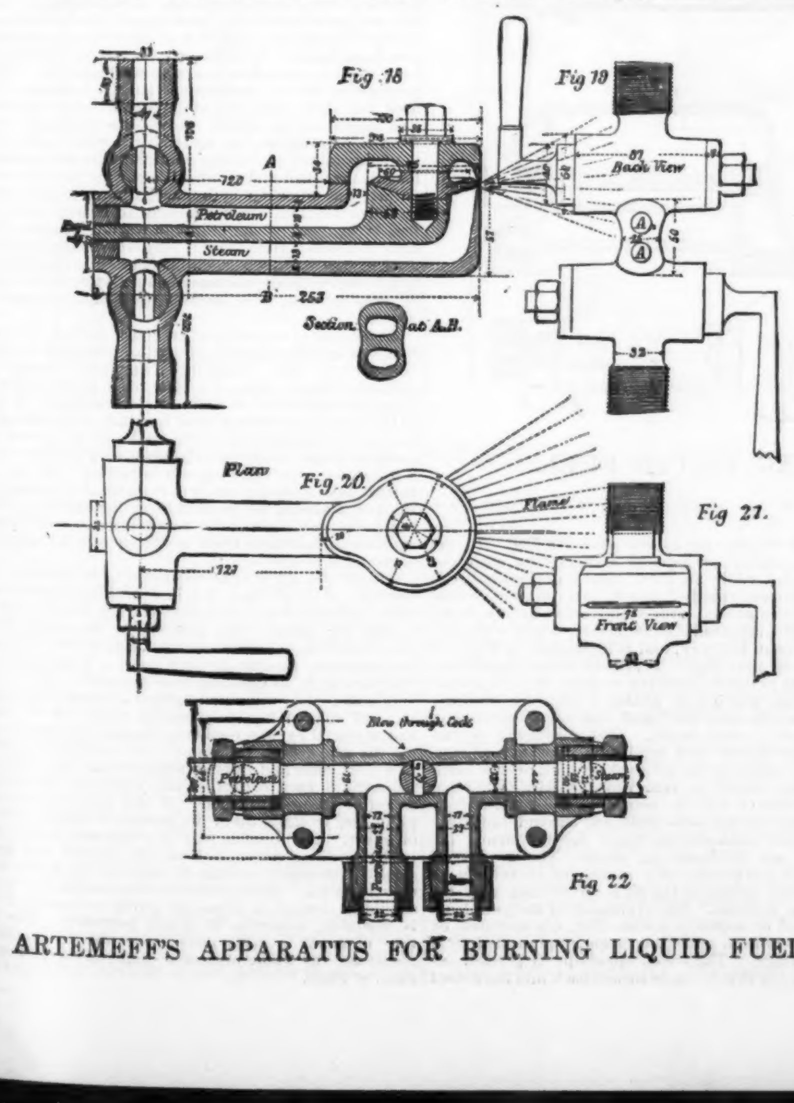
LIQUID FUEL AS USED IN RUSSIA.

THE capabilities of liquid fuel and the method of its employment are but little known in Europe, its use being at present confined almost entirely to the railways and steamers of Southwest Russia, the only country on the Continent where it is found in great quantities. As new districts are opened up, however, by the never-ceasing march of Russia toward the East, and better means of communication are provided, mineral oil will occupy a most important position as a source of power, and its successful employment becomes a subject of no small interest. At present only three railways in Russia, the Trans-Caucasian, the Trans-Caspian, and the Grazi-Tsaritsin, use this liquid fuel on a practical scale, but there is no doubt that all the railways abutting on the lower Volga will ultimately adopt it. Although Russia possesses boundless stores of petroleum, unfortunately they lie on the southwest shore of the Caspian, which has hitherto been in a great measure isolated from Europe generally, and during five or six months of the year from Russia proper, as the Volga navigation season closes about the end of October, and remains icebound until about the 10th of April, so that the main communication is completely stopped during half the year.

In 1882 about 700,000 tons of naphtha were raised, giving, on the average, 30 per cent. of kerosene, a very poor proportion compared with the American product. At present one of the most extensive firms in this business is that of Messrs. Nobel & Co., who have erected splendid works near Baku, on the Caspian Sea. They were able last year to produce 130,000 tons of kerosene, and 30,000 tons of lubricating oil from the residues. Their own steamers are capable of transporting annually about 230,000 tons of kerosene. The capital invested in this big enterprise is ten million rubles (1,000,000*l*.), and the kerosene marked "Nobel & Co" commands in the market a higher price by ten copecks per pood (0·006*d*. per pound) than other brands, thus showing its good qualities. The company erected, at the cost of



LENTS' APPARATUS FOR BURNING LIQUID FUEL.



ARTEMEFF'S APPARATUS FOR BURNING LIQUID FUEL.

400,000 rubles (40,000*l.*), a naphtha pipe line running from the borings and works to the Black Town, a place near Baku. It is eleven versts (7¼ miles) long, and the cost of pumping the kerosene is per pood 2·5 copecks (2d. per cwt.). Formerly the company employed carts and paid for the transport nine copecks per pood (7d. per cwt.). Last year 1,000 tons were occasionally pumped per day, but the machinery is calculated to pump 1,700 tons per day if required. The transport of the kerosene to the various agencies in the towns is effected as follows: The steamers receive the oil from the works direct into their tanks. Arriving at the mouth of the Volga, the cargo is pumped from the tanks into barges having a light draught. These are next steamed to Tsaritsin, where trains composed of wagon tanks are awaiting them. The agents have cisterns, specially constructed outside of towns, into which the kerosene is re-pumped from the wagons. The barrels are provided by the agents themselves. In this way Russia has now cheap and good kerosene. After "Nobel & Co.," "Mirzoeff" is the greatest firm dealing in kerosene. The American kerosene in barrels in Hamburg is sold now at one ruble twelve copecks per pood (0·75d. per pound). The Russian kerosene at the frontier in wagon tanks costs one ruble eleven copecks, when its price at Tsaritsin is 65 copecks (0·4d. per pound). The difference of price of American and Russian kerosene lies now in the price of the barrel, viz., 20 copecks per pood (0·14d. per pound) of the kerosene. If the American product should become a little dearer, the Russian will gain a market in Europe.

Lately, the Trans-Caucasian railway, connecting the Caspian and Black Seas, has been completed from Poti to Baku, with a branch line along the southeast coast of the Black Sea to Batoum, where a natural harbor, said to be much superior to that of Poti, exists. There is thus a prospect that at no distant date southern and western Europe will have a constant supply of Russian petroleum, although from the nature of the line it would be unwise to expect too much from this means of transport. Beginning at Poti, on the Black sea, the line stands about 18 ft. above sea level, from whence it runs east toward the Caucasus Mountains; the first forty miles is made on swampy land, after which the railway rises with gradients from 1 in 125 to 1 in 70, with curves of from 200 ft. to 250 ft. radius. Further on the gradients are 1 in 45 and 1 in 40, and finally the profile changes to 1 in 22¼, landing at the Poni station at the top of the Souram Pass, 3,200 ft. above the sea level. After passing Poni the line goes down a few miles at 1 in 22¼, after which the grades become comparatively easy, even toward the Caspian, the total distance being 402 miles. The line is single, and 60-ton Fairlie locomotives can only take six or seven wagons of about 15 tons each at a time even in favorable weather, consequently there can be no great traffic along this route until a tunnel is bored through the mountains. At present the price of naphtha refuse at Tsaritsin is 21s. per ton, while at Baku, on the Caspian, it is only 2s. 6d. or 3s.

Another outlet for the petroleum is offered in the projected Persian railway starting from Reshd on the Caspian, and running south, via Teheran, to the Persian Gulf. It is confidently expected by those who have studied this subject of liquid fuel, that all the steamers plying in the neighborhood of the Persian Gulf will be eventually fired with naphtha to the complete exclusion of coal.

As mentioned above, Russian naphtha or crude petroleum only yields 30 per cent. of kerosene, while the American variety gives 70 to 75 per cent. From the following table, taken from the *Comptes Rendus*, it will be seen that the chemical compositions of the two do not vary greatly, at least not sufficiently to account for this wide difference, but we have not been able to learn whether this difference is due to the raw material or the method of manufacture.

*Chemical Component Parts of Crude Petroleum and Theoretical Evaporative Power per Pound of Fuel.**

	Specific Gravity at 0 deg. Cels.	Carbon.	Hydrogen.	Oxygen.	Heating Power: British Thermal Units.	Theoretical Evaporation per 1 lb. fuel at 8 Atmospheres.
						lb.
Russian { Light	0·884	86·3	13·6	0·1	22,628	17·4
Russian { Heavy	0·938	86·6	12·3	1·1	19,440	16·4
Russian naphtha refuse.	0·928	87·1	11·7	1·2	19,260	16·2
Pennsylvanian crude heavy	0·886	84·9	13·7	1·4	19,210	16·2

Besides naphtha refuse the only other practically used in Southern Russia in locomotives is anthracite from the basin of the Don. The component parts of this are: carbon, 91·3 per cent.; free hydrogen, 2 per cent.; ash, etc., 6·7 per cent.; and its theoretic evaporative capability is, according to Faure and Silberman, 12·2 lb. of water per pound of coal. Naphtha refuse, of the composition given in the table, has a theoretic evaporative value of 16·26 lb. of water, or nearly 33 per cent. more than that of anthracite. In practice not more than 60 per cent. of useful effect is obtained with anthracite, its performance being limited to the evaporation of from 6·5 lb. to 7·5 lb. of water, whereas with petroleum the performance has lately risen to from 11·25 to 12·25 lb., or about 75 per cent. of the theoretic amount, and there is a prospect that this will be surpassed.

Thanks to the courtesy of Mr. Thomas Urquhart, the locomotive superintendent of the Grazi-Tsaritsin Railway of South Russia, we are enabled to place before our readers engravings of all the principal apparatus that have been tried in Russia, with more or less success, for utilizing as fuel in steam boilers the naphtha refuse remaining from the distillation of rock oil. In every case the principle adopted is the same, namely, that of blowing the naphtha into the furnace by means of a steam jet, which reduces the oily liquid into a spray of fine globules to which the air can gain access on every side.

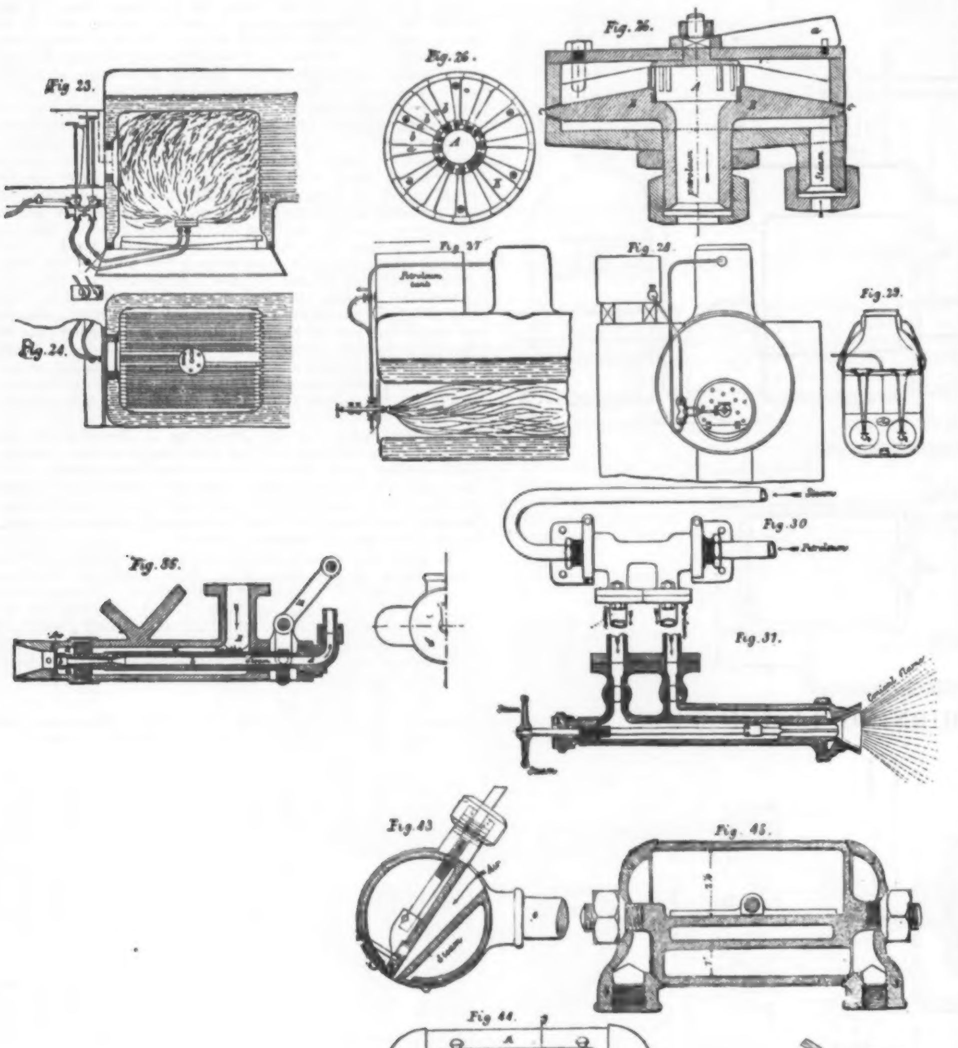
The best known and most widely used of all the pulverizers is that of Lents, which is employed in the steamboats on the Caspian and Volga, and is shown in Figs. 1 to 14 on

* Taken from "Sur les Propriétés Physiques et le Pouvoir Calorique des Pétroles et des Huiles Minérales, Comptes Rendus," tom. lxix., pages 448-453. M. Goulishambaroff.

page 6427. Figs. 12, 13, and 14 illustrate a furnace door with the pulverizer applied to it in such a way that it does not interfere with the opening and closing of the door itself. It consists of two iron horizontal pipes, to the upper of which petroleum is fed and to the lower steam, each pipe being provided with a cock by which the supply can be cut off. The two fluids enter the pulverizer at E and F, Fig. 6, but are prevented from mingling by the diaphragm 4. Notches, Fig. 9, are filed in the edge or lip of this diaphragm, and through them the petroleum trickles, to be blown off by the steam, which escapes at the under side, in jets with intervening spaces for the admission of air. Regulation is effected by two semicircular slides, 3, 3, which are kept to their corresponding faces by spiral springs, and are operated by eccentrics fixed at the ends of the spindles, No. 1, No. 2. Between the two passages is a cock, 5, Fig. 4, for blowing steam through the petroleum orifice if it should get choked by dirt.

Figs. 15, 16, and 17 show this apparatus applied to a locomotive. It has been tried on the Trans-Caucasian Railway, but without favorable results, the main objection to its use on locomotives being that it destroys the tube sheet, starts the tube ends, and does not heat the firebox equally all over. In addition to this the combustion is very incomplete, as is evidenced by the accumulation of a great quantity of soot in the tubes. Its use has therefore been abandoned for locomotives, but it is still a favorite on board ship by cocks from the foot-plate, while the burner stands in the center of the firebox, and delivers a sheet of flame, which is carried upward by the draught and impinges upon all the plates very equally. The objections urged against this apparatus are, that it is uneconomical of fuel, and that should anything go wrong with the burner, the traffic must be stopped to get at it, and some time lost before the parts can be cleaned and replaced. With a high wind, or when an extra energy of blast is developed by the wheels slipping round, the flame is apt to become extinguished, and to require relighting, whereupon the cold air rushes in, no matter how quickly the ash-pan doors are closed, and causes the tube ends to leak so badly that it is almost impossible to keep time. It likewise suffers from the intense heat developed in the furnace, and gets warped and melted, while the petroleum becomes caked in the narrow orifices, and stops the flow. It has been tried on the Trans-Caucasian Railway and the Trans-Caspian Geok-Tepe road.

When applied to stationary and marine boilers Brandt's pulverizer is modified in the way shown in Figs. 27 to 31, and for these purposes it is found to give excellent results, as owing to the conical head, Fig. 31, the flame impinges upon the whole surface of the flue. As an improvement upon the original design, Mr. Ludwig Nobel has introduced the practice of cutting one or more spiral grooves on the conical head to give the flame a rolling motion, which sweeps it along the inner surface of the cylindrical boiler flue.



BRANDT'S APPARATUS FOR BURNING LIQUID FUEL.

and in stationary boilers. The makers are Messrs. Nobel Brothers, of St. Petersburg.

Artemeff's pulverizer, Figs. 18 to 22, is a more simple arrangement, the difference being mainly in the means of regulation, which is by cocks instead of slides, as in the preceding instance, and is found to be more efficient, while at the same time it is much cheaper. The petroleum and steam enter by two passages, and meet round a portion of the diaphragm, where a slot is cut through the outer casing for the emission of the spray. The diaphragm itself is a conical washer, ground up to a close bearing with the lower and main part of the pulverizer, and held in its place by a cap and a single bolt. This arrangement is much appreciated, as in a few minutes the apparatus can be taken to pieces without stopping the boiler, to which it is attached by a swing joint, provided with a blow-through cock, Fig. 22. The engraving, which is dimensioned in millimeters, represents the apparatus fixed to the boiler in the railway works at Tsaritsin.

Figs. 23 to 26 illustrate Brandt's central pulverizer for locomotives. This is a very ingenious arrangement, and is distinguished from all the preceding by having an all-round discharge, so that it gives a tubular flame. The petroleum enters through the central pipe, and overflowing on to the diaphragm, trickles down to the lip, where it meets the steam, and is driven off in spray. The regulation is effected The details of the burner are clearly shown in Fig. 31; the regulation of the steam and naphtha is effected by means of independent cocks, while an extra means of regulation is provided in a screwed spindle, which acts on the conical head. The most improved form of pulverizer known to the present has been Karapetoff's arrangement, which is used on the Trans-Caucasian Railway, and is illustrated on Figs. 32 to 34 and 37 to 46, next page. It is fixed in the firebox door in such a way as to throw a flat fan of flame on to a refractory brick bottom, which soon attains a high temperature, and thus aids in inflaming the small bubbles of petroleum which may reach it unconsumed. This is certainly an improvement upon Lents' first appliance, but were Lents' pulverizer to be placed on an inclined position over a brick bottom, the result would be somewhat similar. Referring to the detail views it will be seen that the apparatus is formed of a drum having loose ends, and through the drum there are cast three channels, the upper for petroleum, the middle for air, and the lower for steam. This method of admitting the air has proved very successful in helping to consume the dense smoke, as the air is in contact with the particles at their ignition. The regulation of the petroleum supply is effected by means of a slide (Fig. 43) operated by a screw and handwheel, while the steam is controlled by a cock or wheel valve. The whole apparatus is pivoted below the furnace, so that it can be turned back into the dotted position, Fig. 38, for inspection or repair. Fig. 39 shows a burner without any regulating slide, while Fig. 42 illustrates the slide shown in Fig. 43.

There exists one other pulverizing apparatus on the Caucasian Railway, that of Kariboot-Daskevick, but it so much resembles Karapetoff's that it is not necessary to dwell on it.

Figs 35 and 36 show two forms of pulverizer made by Messrs. Körting Brothers, of Hanover. In the former the naphtha refuse is dropped through a narrow orifice, C, across the path of a jet of steam and air. The steam enters the pipe, M, through the nozzle, N, drawing air in with it through the orifice, B B, and the two, together with the naphtha spray, are emitted at the conical mouthpiece, D. The arrangement shown in Fig. 36 more nearly resembles an injector; the steam passes along the central channel, A, and meets the naphtha, which traverses the outer annular passages, at a lip, from whence it drives it forward, mingling it with air that enters at the base of the conical outlet. The regulation is effected by sliding the piece, *a*, which carries the lip, forward on the steam pipe, *b*, by means of the lever, M. We are not aware what measure of success has been attained by these apparatus, but they are not employed in Russia for locomotives now. They recall, however, the pulverizers patented by Messrs. Wise, Field, and Aydon, as long ago as 1867, and one of which was tried at the works of Messrs. J. C. and J. Field, South Lambeth. In it the oil was allowed to run through a small orifice, about ⅛ inch in diameter, in a continuous stream, at the rate of about three gallons per hour. As the oil fell vertically it was met by a jet of superheated steam, which forced it into the furnace in the form of a cloud of exceedingly fine spray, at the same time converting it into vapor, which took fire and was consumed perfectly. A second pulverizer, used by Mr. Aydon, at Woolwich, was more like an injector, and also worked well, but the high price of the oil caused the experiments to be eventually abandoned.

The weak point of all these pulverizers which we have described is the uneconomical use they make of the fuel. This is not a great matter in the vicinity of the Caspian, for naphtha refuse can be bought at Baku from two to three copecks per pood (½d. or ¾d. per 36 lb.), but in Russia proper the case is entirely different when the cost of carriage has to be considered. At Tsaritsin on the Volga the price is 17 copecks, and appliances which might seem favorable on the Caucasian line are therefore wholly inapplicable upon the interior railways of the Russian empire. We are informed, however, by Mr. Urquhart that a new form of pulverizer is being introduced which gives far better results than any of the preceding, and when the patent is completed we hope to give engravings of it also, accompanied by a statement of the relative costs of working trains by means of anthracite, wood, and petroleum.—*Engineering.*

SIMPLE PROCESS OF RECOVERING SILVER RESIDUES.

WE will divide the residues into two classes, those consisting of the silver haloids in a state of practical purity—that is, unmixed with organic matter, such as washings of prints—and residues of gelatine or collodion emulsion, spoilt films, etc. This is merely as a matter of convenience, the unmixed haloids being reduced more readily than gelatine emulsion; but if it be preferred the whole may be mixed together. Sulphide of silver and old hypo. solutions are not to be treated in this manner, but must be reduced in the ordinary mode.

We will suppose that a mass of chloride of silver is to be treated. Drain off as much of the water as possible and transfer it to a deep porcelain evaporating basin, or, better still, a tall glass beaker, and pour on sufficient water to cover it to the depth of at least an inch. It will expedite the reduction and save trouble at a later stage if the haloid be rubbed down with a spatula until it is in the form of a smooth paste free from lumps. Now throw in, according to the quantity to be treated, crystals of common washing soda. The exact proportions are not important so long as sufficient alkali is used, but about two parts of carbonate to one of silver chloride appear to be ample. Now place the basin or beaker upon a ring burner, or, preferably, a sand bath, and raise the temperature to boiling point, stirring occasionally. So long as the alkali and silver salt alone are present no change occurs; but immediately the saccharine or organic substance is added the mixture commences to change color, turning first gray, then passing through various shades of brown until it becomes quite black. As regards the material to be used, common brown sugar or molasses is the cheapest, the first being, perhaps, the more convenient. Here, again, the quantity is not of great moment, provided sufficient be employed.

At the end of a quarter of an hour's boiling, if the heat be removed and the mixture allowed to settle the chloride will be found to have changed to a fine, black powder, the supernatant liquid being of a clear, deep brown color, resembling, in appearance as well as smell, caramel. It is better at this stage to extract a small quantity of the silver deposit and test its solubility in nitric acid. If it do not dissolve completely the boiling is to be resumed for a further period, a little more alkali and sugar being added. If the residues treated have consisted solely of chloride or bromide of silver, the result should be perfectly soluble; but if any sulphide be present it will not suffer reduction, and consequently remains as an insoluble black or brown powder when the rest of the mass is dissolved.

Should the silver to be recovered be in the form of waste emulsion or spoilt films, it is only necessary to pour over the mass sufficient water to liquefy it when heated, and to this to add the alkali. The products of the decomposition of the gelatine supply the necessary organic matter to complete the reduction, though the addition of a little sugar or glucose hastens it, as does also free ammonia.

In either case, when the reaction is found to be complete, the dark colored liquid is poured closely off the sediment and replaced by water—this is changed repeatedly—stirring up the whole each time, until the washings are perfectly free from color and from all alkaline reaction. The mass of sediment is then converted into nitrate by the cautious addition of dilute nitric acid. If this latter be added too rapidly, the frothing up of the mixture is liable to cause loss of silver. The solution may be evaporated and crystallized in the ordinary way, or it may be titrated and used as a stock or standard solution by those who prefer to avoid the crystallization. Evaporation to dryness on the sand bath should be resorted to where the purity or freedom from acid is desirable, otherwise it is not necessary. The product thus obtained is quite pure enough for any emulsion purposes, and the whole process is simple in the extreme.—*Br. Jour. of Photo.*

FIXATION OF INDIGO UPON COTTON.

By MM. SCHLIEPER and BAUM.

GRIND up for two days:

Indigo	25 kilos.
Water	100 liters.
Caustic soda, sp. gr. 1·35	50 "
Dry caustic soda	58·53 kilos.

Care must be taken that the temperature does not rise too much during the solution of the soda, not exceeding 40° C. This mixture keeps well and gives a better result when it has been prepared for some time.

For the printing color there is mixed for a dark shade:

British gum	3 kilos.
Maize starch	1·50 "
Water	3·75 "
Caustic soda, at 1·35	16·00 "
The above mixture	30·00 "
	54·00 "

Containing 55·5 grms. indigo per kilo. For medium and light blues, the thickening and the water remain the same, but the soda-lye is increased respectively to 28 and 40 kilos., and the indigo mixture decreased to 18 and 6 kilos., so that in the complete color there may be 33·3 grms. and 11·1 grms. of indigo per kilo.

The British gum is maize starch only two-thirds roasted. It is essential to make use of a good thickening. According to the numerous trials of the authors, maize starch is the best for this color on account of the formation of "apparatine," which takes place under the influence of the soda-lye.

The British gum, starch, and water, are mixed till completely uniform, and the soda-lye is then added by degrees, at first by half liters, and then by a liter at a time, stirring well.

This operation takes an hour; at the end of this time the indigo preparation is added and the mixture heated to 55° in the water bath, stirring well, and then cooled immediately. The color may be used the next day if it has taken a gelatinous consistence. It must be gently heated if it has been exposed for a long time to cold, or if it has not been used for months. The cloth is prepared with glucose at 7·5 to 8° B.; 2½ kilos. glucose to 10 liters water.

The following are the essential points for the use of this color:

The cloth prepared with glucose should be well dried, so that the glucose may retain the smallest possible quantity of water. The color should be very thick and little pressure should be used in printing, so that the color should lie on the surface of the cloth and not penetrate; in other words, there must be two layers upon the cloth, one of glucose and the other of the color. After printing it must be dried very quickly, which is easy, as the color contains but little water; but not too strongly, lest a greenish shade should be produced; it is preferable to leave the pieces slightly moist. The authors dry with air at 60–70° and with Root blowers. The object is to prevent the color from acting upon the color after printing; the reduction of the indigo should only take place on steaming.

Immediately after printing, the pieces pass for 10 to 15 seconds into a small steaming apparatus; this time is sufficient for the complete reduction of the indigo, and if the action were prolonged the indigo would be decomposed. The steaming apparatus must be as small as possible, and is placed over a reservoir of boiling water. The steam should be exempt from oxygen; the action of the air which the piece brings with it is paralyzed by the strong current of steam, continually renewed in this confined space. On leaving the steam the pieces pass for two minutes into a cistern fitted with rollers and supplied with a stream of cold water. Errors committed either in preparing, drying, or steaming may reduce the result very seriously.

The only good resist is precipitated sulphur, 140 grms. of which to a liter of thickening resist the heaviest shades.

Yellow resist:

Cadmium chloride	200 grms.
Precipitated sulphur	140 "
Thickening	1 liter

Red resist: Red liquor, tin crystals, calcined starch, and 130 grms. precipitated sulphur. For nankeens and all ordinary colors use 130–140 grms sulphur per liter.

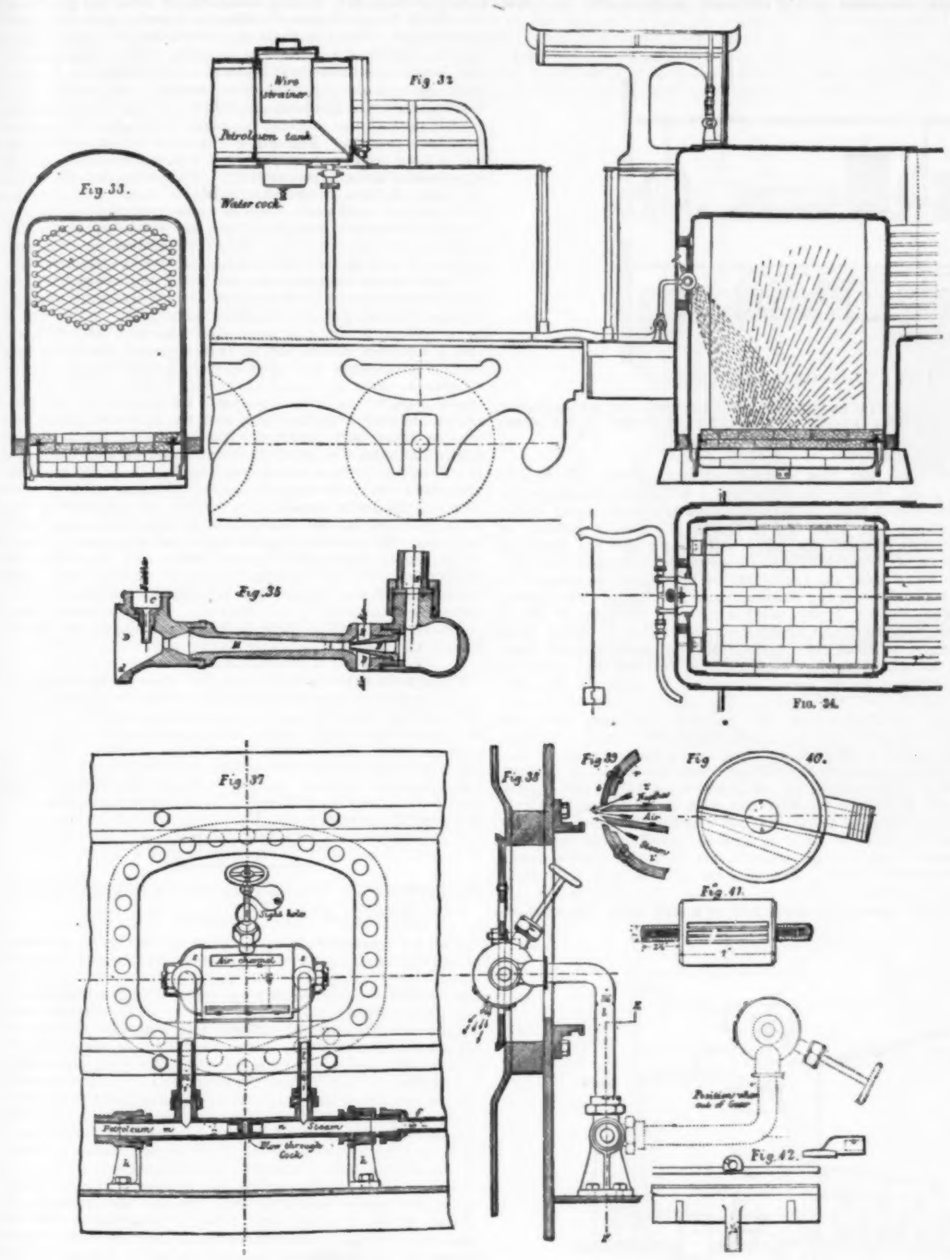
Light Blue.—Upon cloth prepared with glucose there is printed caustic soda, at sp. gr. 1·35, thickened with British gum and maize starch; steamed for 15 seconds and padded with the indigo color. The glucose is destroyed in contact with the soda, the color is only partially developed and gives a light blue. White, yellow, chamois, and light blue resists succeed easily, but for a red resist the cloth must be passed into sal-ammoniac if there is no appliance for quickly removing the soda. An indigo color may easily be discharged upon Turkey reds and upon the mordant for Turkey reds, thus producing very nice styles.

Mordant for Turkey Reds.—We heat for three hours 40 kilos. gelatinous alumina with 64 liters caustic soda 35° B., and make up 300 liters with water. Neutralize with 8 liters hydrochloric acid at sp.gr. 1·50 and make up with water to 620 liters.

Mordant for Padding.—To 4 liters of the above mixture there is added 1 liter water. The padded cloth is dried on the drum, when it turns yellow, but resumes its original color after aging. The pieces are left in a heap till the morning, and are then passed into cold water in a cistern fitted with rollers, well washed, and taken through lukewarm chalk-water to convert the sodium bi- or tri-aluminate into calcium aluminate. When this mordant is ready for dying it can bear taking through sulphuric acid at 8° B., without losing much of its depth. It is the same with the reds dyed with this mordant. Upon this property is founded the production of indigo discharge styles.

Indigo Turkey Red.—The cloth, mordanted for or dyed with alizarin, is saturated with glucose; the indigo color is printed on, steamed, washed, exposed to the air for a few minutes, passed into sulphuric acid at 8° B. for 10 to 20 seconds, washed, passed into weak carbonate of soda and washed. The red pieces are soaped at a boil when the alizarin, which is under the indigo, is dissolved and the blue color appears.

White on Turkey Red and Indigo Blue.—We print on the dark blue and a strong soda-lye, and proceed as indicated. Or we print a strong lye upon the Turkey-red mordant, steam to destroy the glucose, dry, and print on the indigo.—*Moniteur Scientifique; Chem. News.*



LOCOMOTIVE FOR BURNING LIQUID FUEL.

SOLID AND LIQUID ILLUMINATING AGENTS.*

By LEOPOLD FIELD, F.C.S.

SPERMACETI and wax are incapable of improvement by decomposition, but tallow and palm oil only become true illuminators when chemistry has divested them of their grosser components. It is singular to remark how prominent a part France has played in the history of lamps and candles. We have the Sieur de Brez inventing mould candles; Cambacérès, who introduced plaited wick, perhaps as vital and essential an improvement as any; Argand and Carcel, the fathers of the lamp; and last, the greatest, Chevreul, the discoverer of stearine. It is also worthy of note that all the great inventions which confer a luster on this century took their rise in the period intervening between the first and second great French revolutions. The steam engine, the railway, the steamship, the electric telegraph, gas lighting, the penny postage, and the abolition of slavery are all events in that era. I mention the latter with a purpose, because Chevreul's discoveries have tended more to the bringing about of that blessing than missionary labors or acts of Parliament.

This assertion will be proved as we proceed. For the present we will consider what these labors were. In 1811, Chevreul's researched commenced; his first paper saw the light in 1813. In this he announced that fatty bodies were of a composite nature; that tallow, lard, and other fats were not pure compounds, but, in the first place, *mixtures* of hard and soft materials, which, again, were *compounds* of a fatty acid with a substance called glycerine. This discovery is the keynote of the stearine industry; for, until the comparatively uninflammable glycerine is severed from the brilliantly burning fatty acid, and devoted to its own valuable purposes, neither of them can be said to fulfill its legitimate intention. The efforts of all laborers in this field are still directed to the obtaining a fatty acid free from glycerine in the cheapest manner and greatest quantity.

Chevreul published paper after paper, attacking and decomposing one fatty substance after another, until, in 1823, he published the whole of his labors under the title of "Chemical Researches on Fatty Bodies of Animal Origin," perhaps as fine a monument of untiring perseverance, combined with supreme skill, as chemistry has to boast of. But, so far, the tendency of Chevreul's work had been entirely scientific, nor had he attempted to obtain any pecuniary result from his labors. From a keen eye like his own, however, it was impossible that the intrinsic value of his discoveries would long remain concealed. Accordingly, in 1825, he, with Gay Lussac, started a factory for the manufacture of stearic acid, under the protection of patents. But chemical knowledge and technical—or rather commercial—success do not always go hand in hand.

Chevreul's enterprise proved a failure; and it remained for M. De Milly to reap the harvest which the great chemist had sown. In 1832, M. De Milly commenced manufacturing stearine candles near the Barrière de l'Etoile, and produced some very excellent candles which were called by that name. The Société d'Encouragement, of Paris, in the same year, were moved, in consideration of Chevreul's labors, to offer a premium of 4,000 francs to the manufacturer who should produce two tons of candles under the following conditions: The price not to exceed 9d. per lb.; the light to be, weight for weight, equal in amount and brilliancy to that of wax candles; neither to smell, smoke, nor gutter, and to be hard and dry; the multiplying point not to be below 122° Fahr. Messrs. Motard and Milly were successful in their endeavors to obtain this prize, up to a certain point. They produced candles complying in all respects with the conditions, except in that of price, which was nearly double the amount stipulated. In awarding a silver medal to the claimants, the Society expressed a hope that the money prize would be carried off.

It is here necessary to consider the results published by Chevreul, and applied by M. Milly. You have heard that oils are divided into "fixed" and "essential," and that the latter are notqualified to be considered as luminants, differing totally in constitution from the former. I may just remark thatas nearly every natural product yields a separate definite acid, so also it contains a characteristic essential oil. I need scarcely remind you how keen the sense of smell is, which enables us readily to distinguish the hundreds of different odors we come across in daily life, and nearly each of these is due to an essential oil. But the fixed oils can be defined as compounds of a fatty acid with alcohol, either glycerine, as in true fats, or ethyl, cetyl, etc., in wax. Tallow, the most important, is a mixture of stearine and oleine. By simple pressure the latter separates in the form of a brown oil. This is now extensively used in the art of making butter, but is not to be confounded with the commercial oleine used by soapmakers, which is really oleic acid. Stearine consists of stearic acid and glycerine. Palm oil, which is becoming as important a substance as tallow itself, consists mainly of palmitine, which is palmitic acid and glycerine.

In order to effect the separation of these bodies to obtain the palmitic, stearic, and oleic acids in an utilizable condition, three processes are available; the first is that of Chevreul, adopted by M. Milly, called the *saponification* process; the second, perfected by Wilson, is called the *acidification*; and the third, the modification of Tighlmann's invention, called the *high pressure* process. We will take them *seriatim*. The

* Abstract of a lecture recently delivered before the Society of Arts, London.

theory of the saponification process is based upon the fact that glycerine has less affinity for the acids than an alkaline base. Accordingly, if the fat be heated with lime or soda, the glycerine is set free, and a *soap* is formed. If soda be used, the soap is soluble, and, as such, is the ordinary vehicle for removing dirt. But where lime is employed, an insoluble soap is formed. This is the plan adopted for the manufacture of stearine by Chevreul's process. Into a large lead-lined tank, certain proportions of tallow and palm oil are emptied from the original tubs, which are finally steamed. Thereupon a certain amount of slaked lime, varying in quantity with the nature of the fat used, is added, and the whole boiled for some hours with open steam. At the end of the time the tallow of the acids will have combined with the lime to form a hard substance, technically known as "rock;" chemically, as a mixture of stearate, palmitate, and oleate of lime.

The liquid contains the glycerine highly diluted, and is known as "sweet water." The rock is then removed to another lead-lined tank, where it is boiled with strong sulphuric acid. This combines rapidly with the lime to form insoluble sulphate, and the freed acids float on the top. When partially cool they are run into flat pans, and allowed to solidify. The cakes are placed in horsehair bags, and introduced into the hydraulic press. Here they mained so, but for the wise step of removing the duty on soap. It is now, however, almost as important as the stearic acid, being employed for making what is known as pure oil soap, an article in immense demand among dyers and bleachers.

The next process—that of acidification—requires a short history by way of preface. Till now, only tallow had been employed for making stearine, though in 1836 Messrs. Hempell and Blundell took out a patent for making candles from saponified palm oil. These as you see by this specimen, give a fair light, but are dark in color and are greasy to handle, and never became popular. In 1829, Mr. Soames had taken out a patent for pressing cocoanut oil, obtaining a solid and a liquid. This cocoanut stearine was a decided improvement upon pressed tallow, but the candles made from it still required snuffing, and consequently were never extensively used. The composition of cocoanut oil differs very considerably from that of palm oil and tallow; the proportion of glycerine is comparatively small, and the fatty acids very numerous; some of them, as *caproic* and *caprylic*, are volatile at low temperatures and give very pungent vapors, especially when the candle is blown out, which, of course, tended to render this candle objectionable. It was not till Mr. Wilson brought out his composite candle, which I have already described, composed of the cocoanut stearine and the new

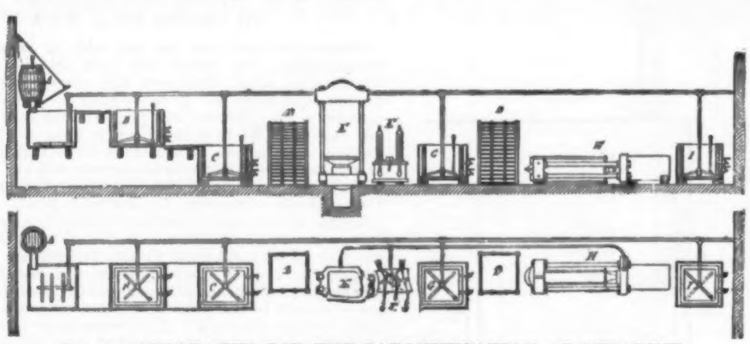


FIG. 1.—APPARATUS FOR THE SAPONIFICATION OF STEARINE.

A, tub from which lime is emitted; B, lead lined vats with steam pipe, for boiling fat and lime; C, ditto, to which rock is transferred, and boiled with sulphuric acid; D, rack holding pans for caking mixed acids; E, cold press; F, hydraulic pump; H, hot press; I, vat for melting refined stearine for casting into blocks.

undergo a pressure at a gentle heat, sufficient to force out the bulk of oleic acid; by this time the cake has assumed a light yellow color, instead of the original dark brown. The oleic acid still contains much stearine, which is removed by various processes, still the subject of much inventive energy, as the relative prices of stearine and olein being as 50 to 30, the success or failure of a factory often depends upon the percentage of stearine obtained.

The cakes are now placed in stronger bags, and subjected to a considerably higher pressure, approaching six tons on the inch, at a temperature of over 120° Fahr. Cast into blocks, they are then ready for the manufacturer. The stearine obtained by this process, as will be seen by the specimens on the table, is beautifully crystalline. It is a mixture of stearic acid and palmitic acid, often called margaric* acid. It is still open to doubt whether margaric acid is a true compound, or simply an alloy of the two other acids. The reasons for believing it to be an independent compound are, that its formula, $C_{17}H_{34}O_2$, is intermediate between those of stearic acid, $C_{18}H_{36}O_2$, and palmitic acid, $C_{16}H_{32}O_2$.

Chevreul first called the fatty acids he discovered margaric and margarous, the latter being stearic acid. Heinty has shown the margaric acid of Chevreul to consist of 90 per cent. palmitic and 10 per cent. stearic acid. All other saponified margaric acids, so called, have been stearic acid, that they became popular. Their sale is still very great, though the composition of the present composite candle differs materially from those first introduced under that name. In 1840, Mr. Gwynne patented a process of distillation *in vacuo* for fatty bodies, and also for distilling fatty acids under atmospheric pressure. Though the principle was mainly the exclusion of air from the apparatus, and was valuable, the working was not found practicable. In 1842, Messrs. Price and Co.—under the name of W. C. Jones—patented the process of distillation of acids from cocoanut oil alone, and also after combination with lime. Very beautiful candles were made by this method, but were still subject to the same complaint as those of stearine, namely, of evolving vapors. The candles made of the product of distillation from the cocoanut lime soap were free from all defects, but their cost was far too great. Various experiments were tried, and patents taken out; but we cannot stop to consider any till we reach the patent of Messrs. Wilson and Gwynne, in 1843, which embodied the suggestion of M. Frémy, to heat oils with acid instead of alkali; only, instead of following his recommendation that the vessel should be kept as *cool* as possible, the patentees recommended a high temperature and distillation under superheated steam. The process will be best understood from the actual description. Tallow oil is subjected to the action of strong sulphuric acid at a very high temperature,

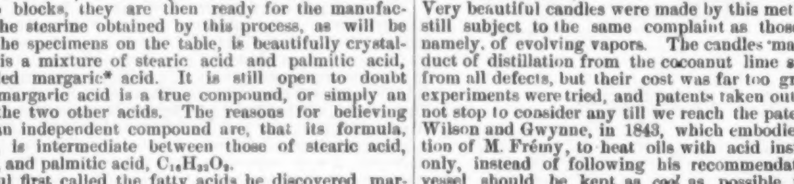


FIG. 2.—APPARATUS FOR ACIDIFICATION AND DISTILLATION OF STEARINE.

A is a tank into which the material to be operated upon is melted from the casks by means of a steam jet inserted in the bung hole. B is one of a series of lead lined tanks for boiling the material before passing it into the copper vessel, D. C is the pump used for the double purpose—first, of charging the copper vessel, D, with the material through the cock, *c*; secondly, of pumping it, after it has been acidified and washed, through the cock. *c c*, into the grease charge tank above the still. D, the copper vessel, is the "Acidifier," made of stout copper, supported either on wrought iron girders or brick work. It has the following fittings, viz., a valve with pipe for the admission of superheated steam; a copper pipe, fitted with a water shower pipe for condensing the vapors in the vessel, produced by the acidifying process; a thermometer for the guidance of the operator, and a gun metal cover at the lower side for cleaning out; to this cover is affixed a cock through which is drawn the acidified materials into the washing vats. E is the acid tank. F is the superheater, the design of Mr. Ed. Field, C.E. G G G G are the washing vats. H is the charge tank for feeding the still. I is the still. K is the refrigerator. *k*, one of the series of iron tanks containing the copper cooling coils. L, the essence tank, fitted with an improved patent safety condenser, which prevents the possibility of any vapor passing away uncondensed. M, a pipe for conveying gas to be burnt in the flue. This description of apparatus is made in several sizes.

proved to be different mixtures of stearic, oleic, and palmitic acids. But an actual margaric acid, of the formula $C_{17}H_{34}O_2$ may be obtained by the action of water on cyanide of cetyl—

$$C_{17}H_{33}N+2H_2O=C_{17}H_{34}O_2+NH_3$$

This is a yellowish body, crystallizing in fine needles. By recrystallization, and partial precipitation, the margaric acid may be made to yield a higher member still, $C_{19}H_{38}O_2$, which has not, I believe, been found in natural products hitherto. The name margarine is, however, too tempting not to be applied, in a good many modulations, to candles of pearly luster by the makers.

One of the great obstacles to commercial success in the manufacturing of stearine was the difficulty of disposing of the oil, which was a waste product, and would have re-

* *Margarita*, a pearl.

in the proportion of 6 tons of the oil to 7 cwt. of acid. By this means the glycerine is converted into sulphoglyceric acid, with evolution of sulphurous acid, and a certain amount of carbon. After the acid treatment, the black mass in the vessel looks anything but promising. A little washing, however, frees it from the residual charcoal and acid, and it is then transferred into a still, into which superheated steam plays, and this, with the aid of gentle "bottom heat," distills over the acid. Here is the raw palm oil of a golden yellow color. Here the black mass produced by the acid treatment, and this firm white substance the product of distillation. In the still a black thick pitch remains, known commercially as palm pitch. What has come over is pure palmitic acid. The medium runnings of the distillate are the best. The first and last are not so good, and are used for inferior candles. From this palmitic acid the finest composite candles are now made. Price and Co. subject their distillate to hot pressure, and obtain the "Belmont Sperm" thereby. You will remark the beauty of their appearance, and the clear luster of the flame. I have here burning, side by side, a candle of tallow and a candle of stearic acid, with equal wicks, and you will perceive at once the difference made by the exclusion of the glycerine. I have forgotten to mention, in the description of the palm oil, the kernel of the nut, from which is obtained a very large amount of oil, equal to, if not exceeding, the quantity produced from the fruit. The composition, however, is quite different, being, in fact, almost identical with that of cocoanut oil, which it replaces in many instances, especially in the manufacture of soap, for which both these oils are abundantly employed. So much for the saponification and distillation processes, of the details of which these fine diagrams and appended explanations will give you a more complete idea. Mr. Tilghmann, in 1854, took out a patent for the separation of fats into acids and glycerine by heating with water under pressure. He suggested pumping the mixture of fat and water through a coil heated to a temperature exceeding 800° Fahr., and at a pressure of 2,000 lb. to the inch. Messrs. Wilson and Payne patented a method by which superheated steam passed into the fat at ordinary pressure effected the separation, and distilled both acids and glycerine. By resubjecting the latter to this process, Mr. Wilson obtained the beautiful glycerine for which Price's Patent Candle Co. have so high and just a reputation. I cannot dilate as I should like to upon the uses and beauties of this beautiful alcohol. They form part of that branch of chemistry known as saponification, a wide reaching and deeply interesting subject. However, Mr. Tilghmann's idea has been amplified, and on the Continent a great part of the stearine is made by what is called the autoclave process. The tallow and palm oil are introduced into a stout copper vessel provided with a stirrer, into which superheated steam is passed till the pressure reaches 250 lb. on the inch. After several hours' agitation at this pressure, the separation is complete. Each of these methods has its particular advantages, and is applied to certain specialties of stearine, in the choice of which experience is the only guide. I have on the table samples of candles produced by all the methods I have named, and many more (which will be particularized in the last lecture on candles). I cannot conclude without drawing your attention to the great results which have followed the discoveries of Chevreul and Wilson. Had it not been shown that by these processes the worst and darkest greases can be forced to yield a clean and beautiful substance, palm oil would have been almost useless to the candle maker. As it is, over forty thousand tons are imported annually into England, and, no doubt, far more into the Continent and America. The kings of the countries where the palm tree grows find that labor of their subjects, in collecting the fruit and extracting the oil, is far more remunerative to them than the selling of these subjects into slavery. Being as keenly alive to their own interests as any white men can be, they have become humane as a matter of business. By encouraging the influx of European goods in exchange for their native productions, they have brought about their own civilization far more rapidly than could have been effected by the simple spiritual pressure of missionaries unindorsed by self-interest. There are many other varieties of tree oils, such as the Cahoun palm, the Bassia butter, and others.

Those for whom the history of the stearine industry possesses sufficient interest would do well to read Mr. G. F. Wilson's excellent lecture on the subject, delivered before the Society of Arts in 1852, and a paper read a short time subsequently, in amplification of the lecture. For the major portion of the above information I am indebted to these records, written by one who should, perhaps, rank next to Chevreul for the share he has taken in promoting this gigantic industry.—L. F.

[ELECTRICAL REVIEW.]

PHILIPP REIS, INVENTOR OF THE TELEPHONE.

By SYLVANUS P. THOMPSON, B.A., D.Sc.

I DO not pretend to write a review of this book, a perusal of which cannot fail to prove conclusively, to any unbiased mind, that Philipp Reis was the *inventor of the telephone;* but I make a few remarks upon certain facts established by the contemporary documents, and by "the contemporary witnesses" cited by the author; and with due deference I offer a few comments upon the "review" by your editorial critic, published in your journal of the 4th inst., with whom I disagree *in toto.* Your reviewer says: "In plain words, almost the whole object of the book is to prove that variations of resistance by surface contact between two substances, as applied to telephony, is really the invention of Reis, and the author's arguments to prove his case, although in our opinion *utterly insufficient*, are worthy of an eminent counsel," and he reproaches the author for persistently, again and again, repeating that "electric mechanism, consisting of two or more parts in *loose or imperfect contact with each other*, was an intentional characteristic of the Reis transmitter." Your reviewer proceeds to say, "that the instrument *was* constructed with loose or imperfect contacts is undoubtedly true, but that such was Reis' intention we submit there is no evidence of any reliability to prove." I submit, can any more reliable evidence be required to prove that Reis' *intention* was to construct an instrument with loose or imperfect contacts, than the fact (admitted by your reviewer) that Reis' "instrument was constructed with loose or imperfect contacts;" in fact, the construction of the instrument proves that Reis' intention was to make the contacts of the most loose and imperfect kind—so loose and imperfect are they that their looseness and imperfectness makes the instrument exceedingly sensible to the action of air waves produced by the human voice, so that the *slightest whisper* upon it will cause variations in the strength of the electric current. I submit, have not all the imitators of Reis endeavored to make a "current regulator" sensitive, so as to avoid the necessity of speaking in a loud tone? How, then, Reis' instrument, in which words spoken in a whisper are reproduced with marvelous accuracy, is objected to, because when words are spoken in a loud tone the articulation is indistinct? I submit that the Reis instrument presents the most beautiful construction of loose and imperfect contacts in a current regulator—a current regulator which will do what no other current regulator, of which I am cognizant, will do, and that is, will reproduce articulate speech in a louder tone than that of the words spoken to it; and to this current regulator only can the term *microphone* be justly applied.

Your reviewer cites the "very fact that Reis chose *platinum* for his contact-points is a proof that he wished to obtain uniformity and completeness in his makes and breaks, and to avoid anything like an imperfect contact." I submit,

can there not be *imperfect* contacts between two pieces of platinum? Cannot there be an *imperfect* contact between two pieces of the best metallic conductors? Professor Hughes' beautiful invention of the microphone is constructed on the principle of loose and imperfect contacts, and did he not construct them of metal? Will your reviewer say that Professor Hughes did not intend to construct his microphone with *loose and imperfect contacts* because he used metals (say, metals of much greater conductivity than platinum)? Your reviewer says: "That Reis' instrument did transmit articulate speech may be admitted, but that it did so as a result of the inventor's endeavor to produce an *undulatory* current and not an intermittent one we cannot admit," and to sustain his assertion he quotes the following words of Reis himself: "The needle reproduces the tone which was imparted by the *interruption* apparatus." I submit, is not an undulatory current produced by rapid *perfect* makes and breaks? Is not this a daily occurrence with the Morse key, when rapidly operated? Are not the effects of rapid makes and breaks visible to the eye when the Bain system of chemically-prepared paper is used to receive the signals? Is it not well known that the recording chemically-prepared paper presents an unbroken, continuous line—broader and darker at intervals, with a narrower and fainter line connecting the broader and darker marks? Is this not the effect of an undulatory current, produced by perfect makes and breaks? It is then clearly evident that rapid makes and breaks will produce an undulatory current. I submit that it is impossible to make rapid makes and breaks without producing undulations in the current. Now, from the construction of Reis' instrument is it not evident that, even if it made "makes and breaks," they are so rapid that it must produce undulations in the current; in fact, the rapidity with which the makes and breaks would be made by it cannot produce the effect of makes and breaks at the receiving end, which can be easily demonstrated by using a Bain chemically-prepared paper receiver with a Reis instrument. I have made such an experiment on a short line from my laboratory to another room, and I find that even when speaking in a very loud tone to the instrument, the line on the chemical paper presented a uniform breadth and depth of color, thus demonstrating that although there were actual makes and breaks of the current by the transmitter, yet they were so rapid that the line on the chemically-prepared paper gave very faint signs of the interruption of the current, showing a line darker and lighter alternately.

Reis certainly speaks of the interruption of the current, and I will admit that his instrument will cause makes and breaks, or interruption of the current, but who will presume to say that Reis did not know that such rapid makes and breaks as his instrument will produce, when spoken to in a loud tone, will produce undulation in a current? Does not Reis, in all his writings, speak of "undulating curves," and in his drawings represent various forms of undulating curves? Who is so bold as to assert as a fact that the instrument of Reis, as the microphone of Hughes, does not act through the delicacy of make and break? Professor Blythe, in the Scottish case, on his examination, expressed himself as follows:

"Speaking popularly, what do you consider the action of the microphone to be?—I am unable to say what the action is, but what appears to me to be the action is the delicacy of the make and break action. It acts through the delicacy of make and break. We know that an interrupted current does produce a musical sound, and we know also that the pitch of the note will depend on the frequency of the interrupting current. Now if we have a sufficiently delicate make and brake, it seems to me quite possible, at least not impossible, that an expert might be able to transmit speech, seeing that articulate speech has an accentuated sound.

"You are still of opinion that that is most probably the action of the microphone?—Yes; of course I do not commit myself to saying, without further experiment, that that is the exact theory.

"Is that view confirmed or not by the fact that sparks are noticed upon the carbon pencils of the microphone when it is seen in operation in the dark?—It is; I have seen sparks emitted from the microphone when it is being used as a transmitter, and that indicates that there is more or less of a make and break.

"And you think that when there is a sufficiently delicate apparatus for making and breaking the current, there is no reason to suppose that it may not transmit articulate speech? They were occasional sparks, and gave evidence of the break at the time I saw them."

Here, then, we have the opinion of Professor Blythe. Other scientific men may entertain a different opinion, but will any of them venture to assert that when there is a sufficiently delicate apparatus, such as Reis', for making and breaking the current, articulate speech cannot be transmitted?

Your reviewer writes: "Great stress is laid upon the use of the word '*tone*,' which Prof. Thompson points out is the German word 'ton,' and is more nearly equivalent to the English word 'sound,' and includes articulate as well as musical tones. In other words, because articulate speech is included under the expression 'tone,' therefore articulate speech as well as musical tones was certainly meant, an argument which fails to convince us." The skepticism of the reviewer must be great indeed; in fact, incomprehensible. Is it not a maxim that the greater includes the lesser?

These facts are fully established by Professor Thompson by the production of evidence which no unbiased person can refuse to accept:

1. Reis' telephone was expressly intended to transmit articulate speech.

As proof of this intention of Reis, Professor Thompson quotes from a prospectus issued by Reis in 1863, these words: "Besides the human voice, according to my experience, there can also be reproduced the tones of good organ pipes and those of a piano." In this same prospectus occur the instructions for the use of the signal call, by which the listener can communicate his wishes to the speaker. These instructions run—one beat=sing; two beats=speech.

2. Reis' telephone, in the hands of Reis and his contemporaries, did transmit speech.

In proof of this fact Professor Thompson cites Professor Quincke of Heidelberg, who testifies that he heard and understood words spoken through a Reis telephone in 1864. Also Professor Bottger, editor of the *Polytechnischer Journal*, published in 1863, who wrote: "The experimenters could even communicate words to one another." "Also several others who give the same testimony, among them Mr. S. M. Yeates, of Dublin, testifies "that in 1865 the instrument was shown at the November meeting of the Dublin Philosophical Society, when singing and words were transmitted."

3. *Reis' telephone will transmit speech.*

In proof of this fact Professor Dolbear, in his paper on "The Telephone," read March, 1882, before the Society of Telegraph Engineers and of Electricians, we find: "The speaker could testify that the instrument would talk, and would talk well." "Reis did transmit and receive articulate speech with his instrument." A great number of persons can testify to this fact; and was not an actual trial of Reis' telephone made openly in court, before Mr Justice Fry, who said, in giving judgment on the case, it is perfectly true that there is some evidence before me that Reis' instrument will speak?"

I forbear to add to this already perhaps too lengthy paper further extracts from Professor Thompson's book, especially as those persons interested in this wonderful invention of Philipp Reis will read the book and judge for themselves.

To Professor Thompson the scientific world owes a debt of gratitude for his indefatigable zeal and well directed and successful researches in establishing the fact that Philipp Reis was the *inventor of the telephone* and also the further fact that the claims set up by others to that invention are without foundation.

August 6, 1883. W. C. BARNEY.

BALL'S ELECTRIC MACHINE.

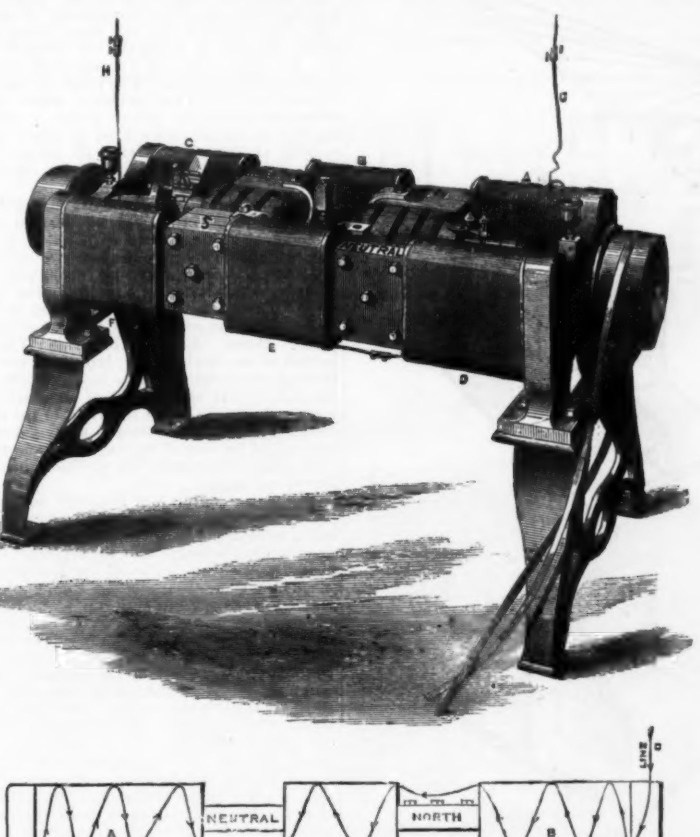
THE peculiar machine which we illustrate has been running some time in London, also in New York, and has been tested by Mr. Robert Sabine, the results of whose tests have been embodied in a report from which we take the following: This machine consists of a long rectangular frame of soft iron, coiled so as to form the field magnets, and which longitudinally supports the axes carrying two bobbins of the Pacinotti type. The main peculiarity of the machine is that each bobbin is rotated in the presence of only one magnetic pole, the opposite side of the bobbin facing a neutral point of the field. Hence the name "Unipolar," by which the inventor designates his dynamo. The effect of this so called unipolar arrangement, in so far as the field is concerned, appears to be that the rectangular soft iron frame is converted into two long electro-magnets with two poles, only one being presented to each of the rotating bobbins instead of four shorter and proportionally weaker electro magnets having four poles as in the ordinary way, by which two opposite poles would be presented to each of the bobbins.

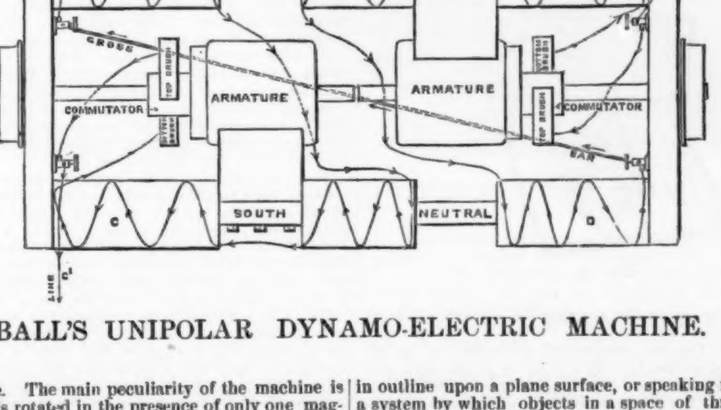
When I tested the system the dynamo was run with six arc lamps also said to be of Mr. Ball's invention, the dynamo being worked on the "series" system, that is to say, field magnets, armatures, and lamps all joined up in series. The speed of the machine was not so regular as could have been desired, and the Morin dynamometer by which the power given to the dynamo was measured, would have worked steadier had it been driven quicker or with a heavier load.

Freedom from repairs is due to the simplicity of construction and the light strain on the straps by which it is driven.

It will be noticed that our engraving shows very narrow driving straps. Those used are as narrow as shown, namely, from about ½ in. to ¾ in. in width and about ⅛ in. in thickness, running on pulleys 8 in. in diameter. The strain on the straps when the machine is running at 1,700 revolutions per minute, and absorbing 5·68 horse power, is not very great, and taking the circumference at 2 ft. the strain would be $\frac{5{\cdot}68 \times 33{,}000}{2 \times 2 \times 1{,}700} = 27{\cdot}5$, and allowing as tightness for adhesion and extra pull of say 7·5 lb., we have a total of 35 lb. as the strain, which, though small, would probably soon destroy a strap say 0·6 in. by 0·25 in.

The diagram given herewith shows the peculiar way in which the winding is connected through the commutators and across the machine. Taking the negative or return wire, C, and following it, it will be found that the circuit is through the right hand commutator round bobbin B, thence to central bobbin, thence back to bobbin D, then along cross bar below the armatures to bobbin A, across to central bobbin next the south pole, and from this to bobbin C, through left-hand commutator, and on to the positive terminal carrying the lead, C.





BALL'S UNIPOLAR DYNAMO-ELECTRIC MACHINE.

PERSPECTIVE, AND ITS APPLICATION TO ARTISTIC DRAWING.*

By J. ROMILLY ALLEN, Assoc.M.Inst.C.E.

THE object of the following paper is, by the aid of a series of models, to give an explanation of the fundamental laws of perspective, and to inquire how far they are applicable to artistic drawing. Plane perspective may be defined as a system, by means of which solid bodies can be represented in outline upon a plane surface, or speaking mathematically a system by which objects in a space of three dimensions may be portrayed in a space of two. There are other purely geometrical methods of effecting this besides perspective, such as orthographic and isometric projection, with which, however, we are not at present concerned. Then, again, in addition to the geometrical methods of representing solids on a flat surface, there is artistic drawing, where mass, light, shade, tone, and color are taken into account as well as mere outline, the object being to give an idea of the picture presented to the mind, and not to reproduce the optical image reflected on the retina of the eye.

The nature of a plane perspective view may best be realized by standing at a fixed distance behind a plate glass window, shutting one eye and looking steadily with the other in a direction at right angles to the surface of the pane of glass; then with a brush full of Indian ink or a piece of soap trace the outlines of the objects outside. In this way a picture will be obtained which, to a certain limited extent, produces the illusion of solidity upon a plane surface. This outline picture on the glass, however, differs from the optical image formed on the retina of a single eye, inasmuch as the surface of the glass is flat, whereas the back of the eye is curved. It differs again still more from the resultant picture formed by combining the views seen by each

* Read before the Edinburgh Architectural Association.

of the eyes from two different points, and finally, this binocular image is not, by any means, the same as the mental conception obtained from it, because the effect produced on the mind by any particular object is influenced and modified by all previous experiences of the same object, and by a variety of other causes, as will hereafter be explained.

The plane perspective view as drawn on the sheet of plate glass is something tangible and capable of geometrical investigation, whereas the mental picture depends on considerations of a very complicated nature, connected with the process which take place in the mind while the transference of the optical on the retina to the regions of thought is taking place. I propose, therefore, to begin by demonstrating some of the most important laws which govern the formation of the plane perspective image, on the assumption that the eye is immovable and the retina flat. When these laws are fully understood, we shall be in a position to judge how far they can be extended or modified so as to be of use in artistic drawing. The optical image on the retina is formed by luminous rays or waves of light which proceed in straight lines from every point of the object looked at, and fall upon the back of the eye, after passing through the small aperture of the lens in front. All the rays converge in order to pass through the lens, and then diverge again afterward. A cross section of the converging rays in front of the lens will be exactly similar (but in reversed position) to a cross section of the diverging rays which fall upon the retina. The image drawn on the sheet of plate glass is then

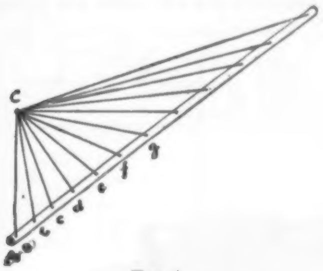


FIG. 1.

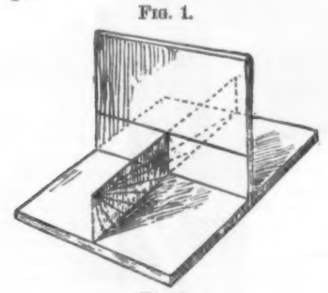


FIG. 2.

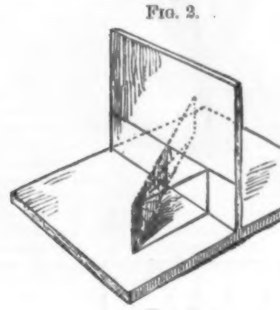


FIG. 3.

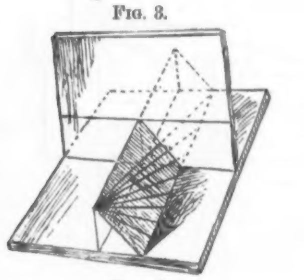


FIG. 4.

the same as the image on the assumed flat retina, only turned upside down.

It thus appears that the perspective projection of an object is simply the intersection by a plane of all the rays proceeding from the object and passing through a fixed point. This fixed point is the center of the lens of the eye, and is called the "point of vision." The intersecting plane is called the "picture plane," and the direction in which the spectator looks is called the "center line of vision." Since the back of the eye is at right angles to the center line of vision, the picture plane must be so also, or a distorted image will be produced. Having made these preliminary remarks, we will proceed to the examination of the models, which are intended to show the reason of the rule that lies at the base of all constructions in perspective—namely, that the perspective projections of sets of parallel lines are either themselves parallel or vanish to a point.

The first model (Fig. 1) is intended to represent the rays which proceed from a straight line in space to the eye, and to show that they all lie in one plane. It consists of a straight rod, A B, to represent the line, and a series of threads to represent the rays knotted together at C, the point of vision, and attached to the rod at *a*, *b*, *c*, etc. That all the rays lie in one plane, is clear from the following considerations: Two points are sufficient to determine a straight line, because, although it can rotate round a single point, when two points are fixed it can only slide forward in its own direction, or rotate round itself as an axis. Three points, not in a straight line, are sufficient to determine a plane, because although it can rotate round an axis passing through two points, when a third point is fixed it can only slide or rotate in its own plane. Now take the plane containing the three points, C, *d*, *e*. Since *f* is in the same straight line as *d* and *e*, and *d* and *e* are in the assumed plane, therefore *f* is in the assumed plane also; and so on with all the other points. I propose to call the plane containing the eye the straight line in space and all the rays proceeding from the eye to it the "ray plane." The perspective projection of a straight line in space is, therefore, the intersection of the ray plane with the picture plane. The second model (Fig. 2) shows the simplest case of this. Suppose the spectator to be standing on one of the lines of a straight level bit of railway and looking in the direction of the line. Since his eye is vertically over the line, all the rays from it to his eye will lie in a vertical plane, whose intersection with the picture plane will give the perspective projection of the line. This is evidently a vertical line, the lowest point of which is where the railway line cuts the picture plane. Now consider the rays proceeding from the line to the eye; the further off the point is from which the ray comes, the nearer the ray approaches to the horizontal, although, however distant the point may be, the ray will never be quite horizontal. In other words, the horizontal is the limit of the inclination of the ray. A similar method of reasoning may be applied to finding the perspective projection of a horizontal line in space lying above the level of the spectator's eye, and vertically over the single line of railway. The inclination of the rays from this line to the eye also are governed by the same laws as in the previous case.

It is clear, therefore, that a horizontal plane will separate all horizontal lines lying below the level of the eye from all those above it, and the intersection of this horizontal plane with the picture plane is called the "horizon." The horizon separates the perspective projections of all horizontal lines below the level of the eye from those above. Since the mean direction in which the eye looks is toward the horizon, this line is taken as a datum from which to measure all heights in perspective. The point on the horizon directly opposite the eye of the spectator, where the center line of vision intersects the picture-plane, is called the "point of sight." It should always be as nearly as possible in the middle of the picture, and all perspective breadths are measured from it as a starting point either to the right or left-hand side along the horizon.

The third model (Fig. 3) shows the spectator still standing on the single line of railway, but instead of looking in the direction of it, his center line of vision is to the right. In this case the perspective projection of the line is a vertical line, which instead of passing through the point of sight, as in the previous instance, now lies to the left of it. The required perspective projection is found by drawing a vertical line through the point where the line of rail cuts the picture plane. Hence the following rule: The perspective projection of any horizon line, lying in a vertical plane passing through the point of vision, is a vertical line, which is to the right or left of the point of sight according as the spectator looks to the left or the right of the line. In the fourth model (Fig. 4) the spectator is supposed to be standing on one side of the line of railway, but looking in the direction of it, that is, the center line of vision being parallel to the line of railway.

The plane containing the rays now slopes toward the side of the line on which the spectator stands instead of being vertical (as in second model), the amount of slope depending on the distance of the spectator to the right or left of the railway line. The intersection of the ray plane with the picture plane is a sloping line, one point of which is where the railway line cuts the picture plane, and another where a line drawn through the point of vision, parallel to the railway line, intersects the picture plane. This latter point is in the horizon, because the railway line is horizontal. In the fifth model (Fig. 5) the spectator stands between the two lines of rails, and looks in a direction parallel to them. In this case there are two ray planes forming the sides of a prism, whose upper edge is a straight line drawn through the point of vision parallel to the lines of rail, and whose two lower edges are the lines of rail themselves.

I propose to call this the "ray prism," because two of its sides contain all the rays proceeding from the eye to the lines of rail. The intersection of the ray prism with the picture plane gives the perspective projection of the two parallel lines of rail. This intersection is a triangle whose apex is the point where the upper edge of the ray prism cuts the horizon, and whose base is the portion of the ground-line lying between the lines of rails. The apex of the triangle is called the vanishing point, because the perspective projections of all lines parallel to the upper edge of the ray prism pass through it. This is evident from the model, as a train of reasoning similar to the above holds good with regard to any other set of parallel lines. The vanishing point here coincides with the point of sight.

The sixth model (Fig. 6) shows the spectator still standing between the two lines of rails, but not looking in a direction parallel to them. In this case the intersection of the ray prism with the picture plane is again a triangle, whose vertex is the vanishing point. The triangle is, however, a skew section of the ray prism, instead of one at right angles to its axis, and the vanishing point, instead of coinciding with the point of sight, lies on the same side of it as the rails. The next case to be considered is where the lines of rails lie upon an ascending or descending plane. In the sixth model (Fig. 6) suppose the lines of rails to be tilted upward so as to bring them into an ascending plane, but being careful to keep them directly above their original positions. The effect of this will be to tilt up the ray prism and to raise the vanishing point above the horizon, but in a vertical line passing through the original vanishing point. A similar line of argument applies to lines in a descending plane when the new vanishing point will be below the horizon, and will lie vertically under the original one. Fig. 7 shows the relation subsisting between the vanishing points of the perspective projections of parallel lines lying in horizontal, ascending, and descending planes.

The following very beautiful theorem in plane geometry results from it, namely: that if the corresponding corners, A, B, C, and A', B', C', of any two triangles lie in lines passing through a point V, and the corresponding sides, B A, B' A' be produced to meet in v_1, B C, B' C' to meet in v_2, and A C, A' C to meet in v_3; then the points v_1, v_2, and v_3 will lie in one straight line. There are two remaining cases which have not been dealt with in the preceding models: (1) That of vertical lines; (2) that of horizontal lines parallel to the picture plane. The perspective projection of a vertical line is found by taking the ray plane in model 2 (Fig. 2), and turning it so as to bring the line of rail into a vertical position. The intersection of the ray plane with the picture plane is evidently a vertical line. The perspective projection of a horizontal line parallel to the picture plane is found by turning the ray plane in model 2 round, so as to bring the line of rail parallel to the picture plane. The intersection of the ray plane with the picture plane is evidently a horizontal line. The following rules have been proved from the models, and are sufficient for the solution of any problem in plane perspective.

1. The perspective projections of points, lying in a straight line, are themselves points lying in a straight line. This follows from the fact that all rays from a straight line to the eye lie in a plane, and the intersection of this plane, with the picture plane, is a straight line. The rule is useful in such problems as finding the perspective projection of the point of a four-sided pyramid which lies directly above the intersection of the diagonals of the base.

2. The perspective projection of any line is found by joining two points in the picture plane, the first of which is where the line itself cuts the picture plane, and the second, called the vanishing point, is where a line drawn through the point of vision, parallel to the original line, cuts the picture plane.

3. The perspective projections of sets of parallel lines are either themselves parallel lines (see rules 6 and 7), or vanish to a point found by rule 2.

4. If the lines are horizontal, the vanishing point is on the horizon, and lies to the right or left of the point of sight according as the lines slope to the right or left of the center line of the vision.

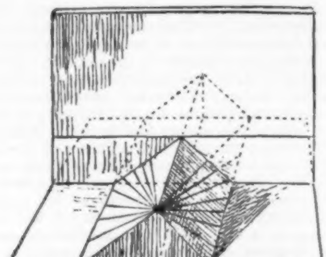


FIG. 5.

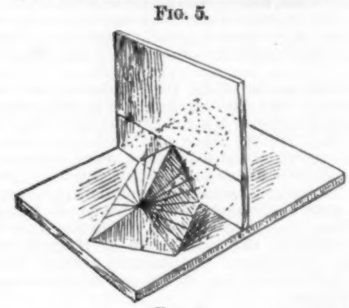


FIG. 6.

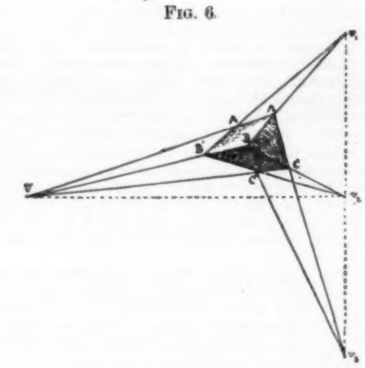


FIG. 7.

FIG. 8.

5. If the lines are in an ascending or descending plane, their vanishing point lies either vertically above or below the vanishing points of their orthographic projections on the horizontal plane.

6. If the lines are vertical, their perspective projections are vertical, and there is no vanishing point.

7. If the lines are parallel to the picture plane, their perspective projections are either horizontal or parallel lines sloping at the same angle as the original line, and there is no vanishing point.

It may here be observed that the difference between the method of proving the rules of perspective which have just been explained, and that usually adopted in text-books on the subject, is that in the former case the line in space is considered in its entirety, and when possible cuts the picture plane, whereas in the latter lines are dealt with in short bits, always lying behind the picture plane. All measurements to scale are made on the picture plane, and therefore every line should be produced to cut it, if the student wishes to fully grasp the problem he is dealing with. The elaborate constructions given in most books on the subject may be enormously simplified by keeping the above principle in mind, and by employing models in preference to flat diagrams whenever practicable.

This concludes the portion of the paper which deals with the laws of plane perspective, and we shall now proceed to consider how far the restrictions imposed by this purely geometrical system of representing solid bodies may be re-

moved so as to make it of use in artistic drawing. As previously stated, a plane perspective picture is the view which would appear to our eye if it could be kept perfectly immovable, and yet see objects reflected on every part of the retina with equal distinctness, assuming that the back of the eye was flat instead of curved, and that the image was conveyed to the brain unaltered or in any way affected by previous experiences.

As it is quite impossible to realize any of the above conditions even approximately, we will consider the effect of removing these limitations one by one. First, we will try the effect of keeping the eye steady, but allowing it to move round so as to take every part of the view. Secondly, we will see what modifications are introduced by looking at objects with two eyes instead of one; and thirdly, we will endeavor to find out what influence previous impressions have in altering our notions of the things presented to our view. The change introduced into a plane perspective view by moving the eye will be best illustrated by showing how the directions of lines are obtained in practical sketching, which is as follows: Hold your drawing-block at right angles to the direction in which you are looking with the left hand, keeping the thumb in front and the four fingers behind. Then take a long pencil in the right hand, and after placing it against the face of the block, gradually raise it above the top, still keeping it in the same plane, and turn it round in that plane until it covers the line whose direction is required. Now bring the pencil down against the face of the block, and sketch in the line parallel to it; repeat the operation once or twice so as to test its accuracy.

It should be observed that the danger to be guarded against is of moving the pencil out of the plane of the block, as there is always a tendency to place the pencil parallel to the line while covering it. Let us now try the operation with any With one eye only open, the letters behind the finger are wholly obscured, but when both eyes are opened the printing can be read through the finger. In binocular vision two images are seen by each of the eyes, but from different points of view. These are combined by the brain (*i. e.*, experience tells us that when two separate images appear in a certain relative position dependent on the distance between the eyes, we know them to be caused by one object only), and our perception of solidity or of the third space dimension is due almost entirely to this.

In binocular vision objects of less breadth than the distance between the two eyes are altogether transparent, and objects of greater breadth have their edges transparent. Plane perspective is thus useful in showing where hard lines are to be avoided. On the above grounds the custom of lining up perspectives with a drawing-pen is much to be deprecated. As long as perspectives are only intended to be flat geometrical diagrams hard lining is admissible; but in this case accessories, such as trees and figures, should be omitted, as they tend to give the idea of an artistic picture, which a plane perspective view can never be. We come lastly to the most difficult portion of our subject, namely, to trace what change takes place in the optical picture reflected upon the retina of the eye during the process of transference to the train. Since this question involves the whole art of painting and no small portion of the science of mind, it will only be possible here to touch on some of the most elementary points.

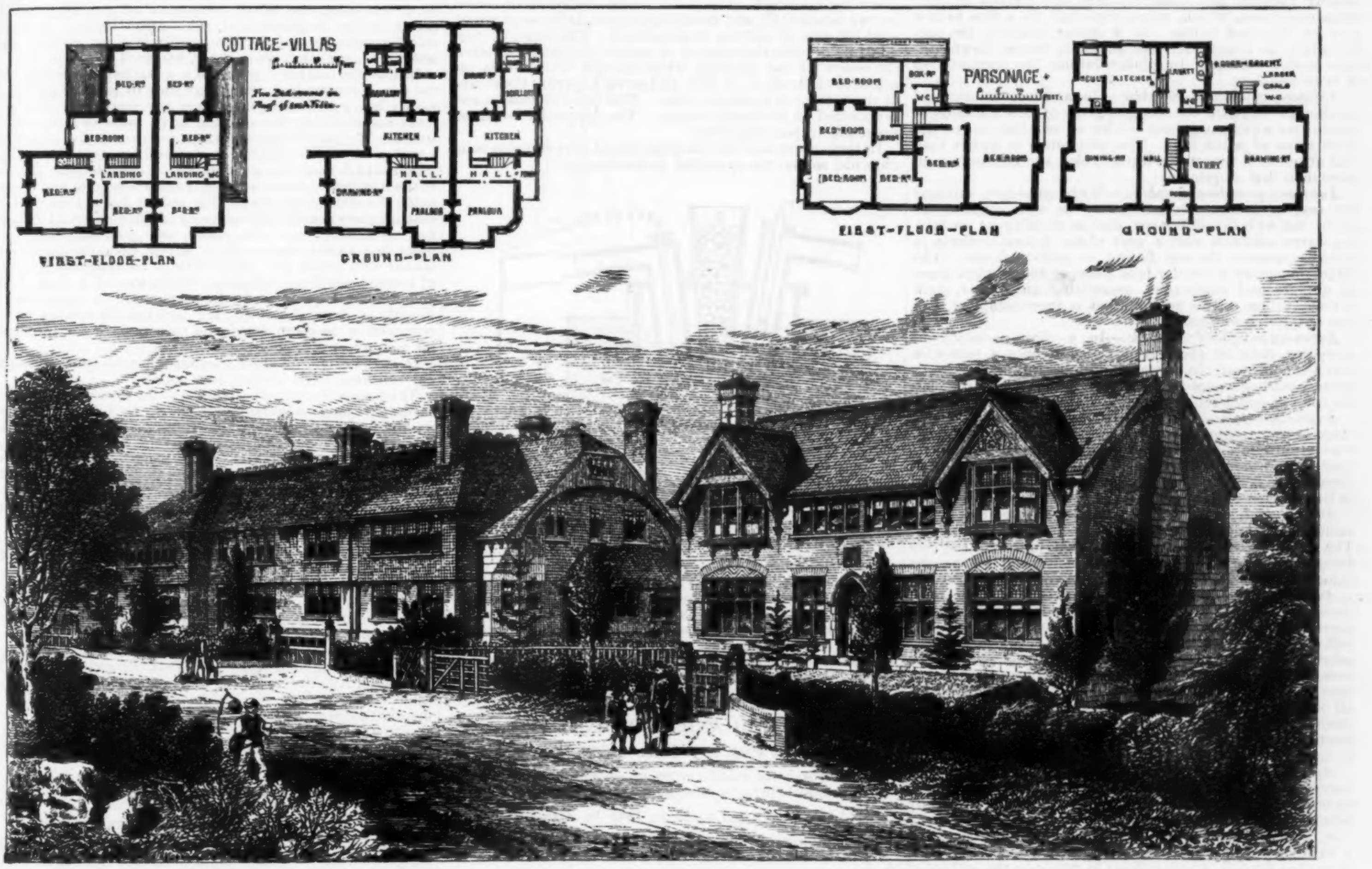
The chief reason of the difference between the optical image and the mental one is that all our ideas of things are the result of previous experiences and that in making a picture we feel inclined to represent, not what we actually see, but what we know to be there. For instance, if a cube be taken up and turned gradually round, the actual effect ob- figures vanish according to the laws of perspective, as shown in some treatises on the subject.

Familiar objects of this kind are often used as a scale to judge of their distance off from the spectator. There is a curious illusion with regard to men seen from a height. A man seen from the top of a cathedral tower 300 ft. high looks a mere speck, whereas a man 300 ft. off upon the level seems but little smaller than when near at hand. This is not due simply to foreshortening, and I believe the explanation to be somewhat as follows: First we use the man as a scale to tell us that we are a great height, then we are impressed with the vastness of the height, and convert this into a notion of vast horizontal distance, and we argue that if a man was at a distance off along the flat which impressed us equally with its vastness, the man would appear very small. There is another still more extraordinary illusion with regard to the sun or moon when setting. This is caused by its appearing as if it were actually upon the horizon, where it can be compared with known objects.

Heights of mountains, or of large masses of building, must always be exaggerated if they are to look natural. The way we argue with regard to this is, that if an object of known height, such as a man, only obscures so small a portion of the sky-surface, how great must be the height of a mountain or building which blocks up so much of our view. A much more natural picture is obtained by judging of objects by their mass rather than by their outline. In fact, the method of blotting out sky-surface at once with color is preferable to that of obtaining the outlines by means of elaborate rules, and then filling them in afterward.

In conclusion, the results arrived at are as follows:

1. Plane perspective projection is a useful system for drawing flat diagrams to illustrate the forms of buildings, but



COTTAGE VILLA RESIDENCES AND PARSONAGE, CROWBOROUGH, SUSSEX.

horizontal line such as the cornice of the ceiling of a room. Standing directly facing the wall, so that the center line of vision is at right angles to it, the cornice will appear horizontal; but as the eye is moved to the right or left, the line will begin to slope down toward the horizon in either direction. If the operation is made continuous, the perspective projection of the line becomes curved, and is, in fact, a spherical projection instead of a plane one. The gradations of breadth in spherical and plane projection are quite different, as may be seen by drawing a row of columns of equal size when standing directly facing them. It will be found that the spherical projection gives their breadths all equal, whereas plane perspective actually makes the ones which are further off appear larger than those close to the spectator.

A system which involves such absurdities must necessarily be false. In order to get over these difficulties I would suggest following the laws of plane perspective about vanishing lines only to a limited extent. Thus, draw the line which slopes most at the top of the picture, and fill in those between it and the horizon by the eye, taking care however that no line which is at a higher level shall slope less than one which is at a lower. Long lines may be slightly curved with advantage. The gradations of breadths must be treated somewhat in a similar manner, only keeping in mind that in dealing with objects of equal size the one which is far off must be made smaller than the one which is near. Next, as to the difference between monocular and binocular perspective. This may be exemplified by two simple experiments:

1. Take up a tableknife, and hold it with the edge of the blade pointing toward you. When one eye is shut the edge appears as a hard, distinct line, but when the other is opened both sides of the blade can be seen at once (which would be impossible, according to the laws of plane perspective), and the edge becomes more or less blurred instead of sharp. 2. Hold up your finger in front of a printed page. served is three contiguous quadrilateral figures whose size and shape are continually changing. From previous experience, however, we associate these changes of shape in plane figures with the rotation of a solid body, each of whose sides, when seen in elevation, is a square. In fact, from each side as it appears distorted in perspective we form an estimate of what it would look like in elevation. The retinal image is three irregular four-sided figures, while the mental one is three perfect squares. It would, of course, be impossible to represent solids on a flat surface if all their sides were to be seen simultaneously and shown in elevation, and artistic drawing is generally a kind of compromise between representing objects as they appear to the eye and as we know them to be.

Take, for example, the intersection of the gabled roof shown on Fig. 8. In perspective it appears as a vertical straight line; but if we concentrate our attention on the right-hand gable, knowing the line to be on the sloping side of the roof, we shall expect it to incline in that direction; and so also a similar illusion will take place when fixing the mind on the left-hand gable. In every view which is presented to the eye, the majority of the objects are familiar because they have been seen hundreds of times before. The idea conjured up in the mind when the eye rests on any one of these familiar objects is the resultant of all previous impressions of that same object as obtained by means of the senses. When the eye rests on anything, it only does so sufficiently long as to recognize it, and then immediately follows the mental ideal which has gradually been built up as the result of experience. Take, for example, the human figure; every one has in his mind's eye an ideal man, probably of the size and general appearance of an ordinary individual, at the average distance off at which one is accustomed to look at people. The consequence is that a man a hundred yards off looks very little smaller than when he is only ten yards away from the spectator. No artist would venture to make human elaborate shading and accessories intended to convey the idea of a sketch from nature are to be avoided.

2. Plane perspective may be made to look more natural by slightly curving the vanishing lines and altering the gradations of breadth.

3. The effect of solidity is obtained by obliterating outlines.

4. Really artistic views of buildings can only be produced by persons in the habit of drawing things as they see them, and the best method of doing this is by blotting out sky-surface, or expressing objects by their masses rather than by their outlines. In addition, it is necessary thoroughly to grasp the idea of solid form; that is, to learn to think in three dimensions instead of two. The system of plane perspective and plane drawing generally has a most pernicious effect in confining the ideas to one plane. Above all things, do not waste time on the elaborate constructions given in the text-books on perspective and taught in schools of art, which are wholly unnecessary, and tend to disgust the student with a really simple and interesting branch of knowledge.

COTTAGE VILLA RESIDENCES.

THIS building is in course of completion, and has been erected from the designs of Messrs. Satchell and Edwards, of 37 Norfolk Street, Strand, the architects of the adjoining cottage villa residences shown in our illustration, as also of the church for which this parsonage is being provided. The latter contains study, drawing and dining rooms, six bed-rooms, and the usual offices. The former contains three sitting-rooms, six bed-rooms, and customary offices, and were erected to meet the growing demands of this most charming neighborhood, than which it would be difficult to find a more healthy or interesting locality nearer to London. The whole are of a studied, simple, and inexpensive style.—*Building News.*

REAGENTS FOR VEGETABLE ALKALOIDS.

By R. PALM.

I. SODIUM SULPHANTIMONIATE, OR SCHLIPPE'S SALT.

SOME years ago I called attention to the group of alkaloid sulphides, proving that the salts of the alkaloids are precipitated with a yellowish color by solutions of alkaline sulphides and persulphides, and I have further demonstrated the existence of alkaloid double sulphides, which are formed when solutions of alkaloid salts come in contact with the solution of sodium sulphantimoniate. The characteristically colored precipitates thus produced consist of alkaloid sulphide + antimony sulphide.

On mixing very dilute solutions of the alkaloids, and of the reagent, both as neutral as possible, the precipitations appear at first colorless, or milky suspensions; on exposure to the air they turn more or less yellowish, and in concentrated solutions they appear at once yellow, or in different shades up to a reddish-brown, and in saturated solutions there are formed resinous masses.

In dilute solutions the precipitation is more complete than in the more saturated. Gentle heat and the addition of strong alcohol promote the separation. An excess of sodium sulphantimoniate dissolves the first formed yellow precipitate in most cases. The double sulphides are, with few exceptions, amorphous, and dilute acids extract the alkaloid from them but partially. The reactions are in general sensitive, but I have not yet succeeded in ascertaining either their limits, or the chemical constitution of these double salts.

Antimony-quinine Sulphide.—In dilute, neutral solutions of quinine sulphate, the reagent produces merely a milky turbidity; in strong solutions there is formed at once a yellow flocculent precipitate, which, on shaking, coagulates in resinous lumps and becomes gradually darker. On mixing together hot solutions there are formed at once resinous masses, which, when dry, fall to a fine yellow powder, like lead iodide. In a strong solution the precipitation is imperfect, since ammonia throws down quinine from the filtrate. In dilute solutions the precipitation is more complete.

Antimony-cinchonine Sulphide.—In a dilute solution of cinchonine sulphate the reagent gives at once a flocculent precipitate which coagulates neither on standing nor on the application of gentle heat. The precipitate is darker than that of quinine, almost of a leather color, and it is more complete than that of quinine.

Antimony-quinidine Sulphide.—With quinidine sulphate the reagent behaves almost exactly as with quinine sulphate, but with this difference, that on shaking or on mixing warm solutions only a part of the deposit collects in resinous masses, the rest falling as yellow flocks. The entire precipitate when dry is of a deeper yellow than those of quinine and cinchonine, resembling an intense, dark chrome yellow. The precipitation is more complete than that of quinine sulphate.

Antimony-morphine Sulphide.—In a dilute solution of morphine chloride there is produced at once a yellowish flocculent deposit; in strong solutions the precipitate is darker, but less complete. The precipitate, when dry, has the color of powdered gamboge.

Antimony-codeine Sulphide.—In the solution of codeine chloride the reagent gives immediately a floccy precipitate. In dilute solutions the precipitation is more complete than in the more concentrated. The color of the deposit when dry is paler yellow than that of morphine, resembling in its tone that of quinidine.

Antimony-narcotine Sulphide.—In concentrated and in hot solutions the precipitates coagulate in resinous masses. The reaction is much more sensitive than in case of the two foregoing opium alkaloids. The deposit when dry has the color of precipitated and dried ferric hydroxide.

Antimony-strychnine Sulphide.—Even in very dilute solutions of strychnine nitrate the reagent occasions a flocculent precipitate, colorless at first, but gradually turning to a pale yellowish color, on exposure to the air. In concentrated solutions there is formed at once a rich yellow, homogeneous flocculent precipitate, which even on prolonged standing does not coagulate. The reaction is more sensitive than with all other vegetable alkaloids, the strychnine being entirely thrown down. The color of the deposit when dry is a fine, intense, deep golden-yellow. The precipitate is not soluble in an excess of the reagent.

Antimony brucine Sulphide.—If the reagent is added in successive portions to a moderately concentrated solution of brucine nitrate, three distinct precipitates can be plainly observed.

a, a reddish yellow, which collects in resinous masses; *b*, a light golden yellow flocculent deposit; and *c*, a colorless, flocculent deposit, which collects in crusts on the surface of the liquid.

On boiling the mixture of these three precipitates in water the greater portion dissolves, leaving an amorphous, deep-orange residue. From the filtrate there crystallizes out, in the course of ten minutes a pale yellow double sulphide in fine acicular tufts.

The liquid filtered from these crystals is still bitter, and if placed in a refrigerating mixture there is deposited in the course of a few hours a pale, yellow, crystalline powder which is also a double sulphide. Crystalline deposits form also at common temperatures in the liquid filtered from the precipitate without previous boiling with water.

Antimony-atropine Sulphide.—In a strong solution of atropine sulphate the reagent occasions at once a yellowish deposit, which coagulates on shaking or heating. The reaction is not very sensitive, and the color of the dried precipitate is a lighter yellow than that of morphine.

Antimony-bebeerine Sulphide.—The reagent produces in the solution of bebeerine chloride an immediate dark-colored precipitate, which coagulates in strong and especially in hot solutions. The color of the double sulphide when dry is a grayish brown. All the double sulphides above mentioned are very stable. That the alkaloid sulphides can form double combinations with other metallic sulphides which are soluble in alkaline sulphides can scarcely be doubted.

II. LEAD CHLORIDE AS A REAGENT FOR VEGETABLE ALKALOIDS.

For this purpose we may use a solution of lead chloride either in water or in sodium chloride, which dissolves more lead chloride than pure water. The solution in either case is prepared hot. The alkaloids must not be employed as sulphates, as the lead would be precipitated by the sulphuric acid. The acetates, nitrates, or chlorides may be used—the last mentioned by preference. Most of the vegetable alkaloids are precipitated by this reagent in a colorless, finely crystalline state. The reaction is less sensitive than that of sodium sulphantimoniate. The precipitates obtained consist of lead chloride and an alkaloid salt.

Quinine is thrown down in pulverulent crystals; cinchonine, morphine, and codeine in small, fine needles. Strychnine, when dry, forms an asbestos-like felted mass, showing distinct crystalline forms. Brucine gives a fine crystalline powder. In many alkaloids the crystalline deposits appear only after prolonged standing.

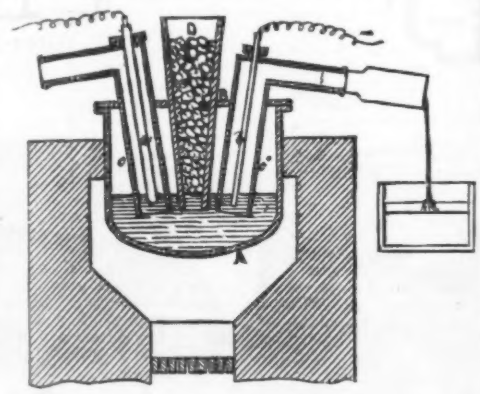
III. SODIUM CHLORIDE AS A REAGENT FOR BEBEERINE.

Sodium chloride shows a remarkable behavior with bebeerine cloride, the alkaloid of the tree *Nectandra rodia*. If a strong solution of sodium chloride is mixed with a solution of the alkaloid, the latter is completely reprecipitated and with its original dark color. Even in very dilute solutions of the alkaloid the separation is complete. This process might be utilized for the industrial preparation of bebeerine.—*Zeitschrift für Analytische Chemie; Chem. News.*

MANUFACTURE OF SODIUM AND OTHER ALKALINE METALS BY THE ELECTROLYSIS OF THEIR SALTS ALONG WITH HEAT.

THIS invention, due to Mr. P. Jablochkoff, consists in the melting of the salts of the alkaline metals and decomposing the melted salts, by means of an electric current, in an apparatus so arranged as to isolate the gases due to the decomposition; or that, on the one hand, the metal may be collected, and, on the other, the gas that was combined with it in the salt. These apparatus may have different arrangements, and one of these we shall describe. The accompanying cut represents a section of an apparatus for the manufacture of sodium. It consists of a crucible, A, of refractory clay, closed by a cover, B, of the same material, which is traversed by two tubes, C C', and the charging tube, D, through which solid chloride of sodium is introduced. The tube, C, contains the positive electrode, *a*, of carbon, and serves to allow the escape of the chlorine, while the tube, C', contains the negative electrode, *b*, of iron, and serves to permit the escape of the sodium in a gaseous state. This latter condenses and is collected in the usual manner. The apparatus is placed upon any furnace whatever.

In these apparatus the charging tube always contains solid chloride, so that the operation is continuous.



The inventor has likewise patented a method of manufacturing two metals simultaneously, in employing a double salt, and particularly the manufacture of sodium and aluminum, the latter capable of being taken from the crucible without interrupting the work. He has also patented the utilization of the chlorine escaping from the apparatus to excite the pile that produces the electric current.

PHENETOL AND ITS DERIVATIVES.

By Prof. E. J. HALLOCK, Ph.D.

PHENETOL is the ethylic ether of phenol, the ethyl and phenyl radicals being united by an atom of oxygen, thus: $\left.\begin{matrix}C_6H_5\\C_2H_5\end{matrix}\right\}O$. It was first made in 1849 by Cahours,[1] and a large number of its substitution products have been prepared, but as most of them have been derived from other substances than phenetol, their literature is only to be found by a tedious search under various headings. Having had occasion to hunt up these various references, the author has felt that it might be useful to arrange the facts already known in regard to phenetol in systematic order for the use of future investigators.

Phenetol was first made by the dry distillation of the ethyl salicylate of barium. Cahours[1] described it very accurately as a colorless, mobile liquid, lighter than water and insoluble in it, boiling at 172° C. Baly[2] made it about the same time and by the same method, but called it salitbol. He gave its boiling point as 175°. About two years later Cahours[3] described a new method for its preparation, viz., by heating ethyl iodide with phenol and potassic hydrate in closed tubes at 100° to 120°. Also by distilling together phenol, potassic hydrate, and potassic ethylsulphate. Recently a new method has been published, viz., to heat an alcoholic solution of phenol with zinc chloride, or phosphoric anhydride. These methods, which are suggested by Katastropp,[4] do not seem to be of any practical value. More recently H. Kolbe has prepared it by heating together sodic ethylsulphate and sodic phenol under a pressure of seven atmospheres at 150° C.

In 1869, Fittig and Kiesow[5] prepared a substance having the same composition as phenetol, by acting upon the potassium salt of ethylbenzolsulphuric acid with potassic hydrate at a temperature of 270° to 280°, acidulating with sulphuric acid, and distilling. The substance thus obtained, when freed from water, boils at 208° to 210° and solidifies to a mass of crystals which melt at 47° to 48°. It liquefies in contact with water. In the same year Beilstein and Kuhlberg[6] obtained and described a body having the same melting point, but boiling at 214° to 215°, and made in the same manner.

[1] Annales chim. phys. [3], xxvii, 461; J. pr. Ch., xlix, 281.
[2] Quar. J. Chem. Soc., ii, 28.
[3] Comptes Rendus, xxxii, 60.
[4] Berl. Berichte, x, 1685.
[5] Zeitsch. Chem., xii, 33.
[6] " " xii, 461.

BROMOPHENETOL.

Parabromophenetol is a colorless liquid, boiling, according to Lippmann,[7] at 233°. It is readily prepared by the direct action of bromine upon phenetol, also ethyl bromide upon phenol silver. Nitric acid converts it into nitrobromphenetol.

CHLOROPHENETOLS.

Orthochlorophenetol was made by Beilstein and Kurbatow in 1874 from chlorophenol.[8] It is a liquid boiling at 208° to 208·5°. They also prepared the para compound in a similar manner.

Parachlorophenetol was first made by Henry[9] in 1869 by the action of phosphorus pentachloride upon phenetol. Also by the author in 1880 by mixing phenetol with potassic chlorate and slowly adding hydrochloric acid.[10] It melts at 21° and boils at 210° to 212°. It has a peculiar odor not unlike oil of anise.

The meta compound has not yet been described.

Dichlorophenetol was made by Henry[9] by the action of ethyl iodide upon dichlorophenol. It is a liquid nearly insoluble in water and boiling at 236°.

Trichlorophenetol was made by Faust[11] in the same manner as the last mentioned. It crystallizes in white prisms which melt at 43°-44°, boil at 240°.

NITROPHENETOLS.

Orthomononitrophenetol is a liquid boiling at 258°, according to Groll,[12] who obtained it from orthonitrophenol by heating the latter with potash and ethyl bromide in alcohol to 140°-160° in closed tubes for several days.

Metanitrophenetol was prepared by Bantlin[13] from metanitrophenol. It melts at 34°, boils at 264° at ordinary pressure with partial decomposition; under 70 mm. it boils at 169°.

Paranitrophenetol was first made by Fritzsche[14] in 1858 by decomposing the silver compound of paranitrophenol, called by him isophenic acid, with ethyl iodide. It forms colorless prisms which dissolve readily in ether, alcohol, and acetic acid, are insoluble in water, and melt at 57° to 58°.

In 1879 the author[15] prepared a considerable quantity of the para compound in a very pure state by pouring phenetol slowly into cold fuming nitric acid (the reaction is very violent), and distilling the resulting tarry mass in a current of steam. The para compound is carried over in the steam as a yellow oil which solidifies to a crystalline mass. If concentrated acid is used, but not fuming, a considerable portion of the distillate remains a liquid, even below zero, and is probably the ortho compound. The author did not succeed in obtaining any considerable quantity of this compound by heating paranitrophenol with potash and potassic ethyl sulphate in a closed tube at 120°. When paranitrophenol was heated with potash and ethyl iodide, a considerable quantity of nitrophenetol was obtained, which was of a dark color and difficult to purify. In the preparation of nitrophenetol directly as above described, the non-volatile residue which remained in the retort was found to contain a dinitrophenetol melting at 80°.

In 1881 Willgerodt made paranitrophenetol from paranitrochlorobenzol, ethyl alcohol, and potash.[16]

The author would call attention to the fact that phenetol seems to form para compounds by preference when acted upon by violent reagents like fuming nitric acid, or chlorate of potash and hydrochloric acid, and even bromine. Paranitrophenetol was also formed when sulphuric acid was added to a mixture of phenetol and potassic nitrite. While pure phenetol is converted into nitrophenetol only with difficulty and loss, the chloro and bromo phenetols are very easily nitrated.

Dinitrophenetol. — According to Salkowski,[17] there are two of these, of which alphadinitrophenetol melts at 84°, betadinitrophenetol at 57° to 58°.

Cahours[18] says that he obtained dinitrophenetol by the action of fuming nitric acid upon phenetol and boiling. Salkowski prepared his compounds from the corresponding phenol compounds, as did Gruner.[19] Beilstein and Kuhlberg[6] made a dinitrophenetol melting at 86° to 87° by the action of concentrated nitric acid upon ethylparaoxybenzoic acid. P. Townsend Austen[20] made the dinitrophenetol by dissolving dinitrochlorobenzole in absolute alcohol and slowly adding metallic sodium. He also prepared a trinitrophenetol from trinitrochlorobenzole. An attempt to make the mononitrophenetol in the same manner was unsuccessful. He omits to give the melting points.

Trinitrophenetol was prepared by Muller and Stenhouse[21] by the action of ethyl iodide upon picrate of silver.

BROMO AND CHLORO NITROPHENETOLS.

Parabromoorthonitrophenetol was first described by the author[22] in 1881. It was obtained directly from phenetol by first treating it with bromine, and then acting upon the well-washed bromophenetol with strong nitric acid. The resulting product is at first a thick oil, but solidifies on standing to a mass of yellow crystals, which melt, after purification by recrystallization, at 47° C. They have an agreeable aromatic odor, and by reduction with tin and hydrochloric acid yield the corresponding bromoamidophenetol.

Orthobromoparanitrophenetol.—An attempt to prepare this compound by the action of bromine upon an alcoholic solution of paranitrophenetol gave unsatisfactory results.[23] The compound obtained when little or no heat was employed, was a crystalline solid melting at 54°, while that obtained at a higher temperature melted at 138° C.

Staedel[24] described a monobromoorthonitrophenetol obtained by acting upon the phenol compound with ethyl iodide, which melts at 43°. Also a monobromoparanitrophenetol, which melts at 98°. The former resembles that obtained by the author, the latter does not. Dibromoparanitrophenetol melts at 108° (Staedel).

Parachloroorthonitrophenetol[25] may be made by the action of strong (not fuming) nitric acid upon the parachlorophenetol obtained as above described. It crystallizes in white needles melting at 61° to 62°. It was also prepared by Faust

[7] Wien. Akad. Ber., lxii, 611.
[8] Berl. Berichte, vii, 1395.
[9] Zeitschr. Chem., xiii, 247.
[10] Am. Ch. J., ii, 258; Berl. Berichte, xiv, 37.
[11] Zeitsch. Chem., x, 727.
[12] J. pr. Chem. [2], xii, 207.
[13] Berl. Berichte, xi, 2101.
[14] Petersb. Acad. Bull., xvii, 145; Ann. Ch. Pharm., cx, 155.
[15] Am. Ch. J., i, 271.
[16] Berl. Berichte, xiv, 2636.
[17] Ann. Ch. Pharm., clxxiv, 263; Berl. Berichte, vii, 371.
[18] Annales Chim. Phys. [3], xxvii, 461.
[19] J. pr. Chem., cii, 222.
[20] Berl. Berichte, viii, 666.
[21] J. pr. Chem., xcvii, 255.
[22] Berl. Berichte, xiv, 37.
[23] Am. Ch. J., iii, No. 1.
[24] Ann. Ch. Pharm., ccxvii, 55.
[25] Am. Ch. J., ii, 258.

and Saure[26] by heating the silver compound of chloronitrophenetol with ethyl iodide.

Orthochloroparanitrophenetol was prepared by the author in 1881, by the action of potassic chlorate and hydrochloric acid upon paranitrophenetol.[29] The crystals melt at 77°.

Parachlorobetadinitrophenetol has been made by Petersen and Baehr-Predari.[27] It melts at 54° to 55°.

AMIDO AND AZO COMPOUNDS.

Orthoamidophenetol is a liquid heavier than water, boiling at 228°. It was made by Groll,[19] by reducing the orthonitrophenetol with tin and hydrochloric acid.

Paraamidophenetol, made by the author[15] by the reduction of paranitrophenetol with tin and hydrochloric acid, is an oil boiling at 253°. The hydrochloride, which crystallizes in rhombic plates, forms with platinic chloride a beautiful double salt, crystallizing in golden scales, but it soon decomposes, rendering analysis impossible. With carbon disulphide the amido body forms a solid white compound; with acetyle chloride a crystalline body, not examined farther.

All attempts at the reduction of the paranitrophenetol (melting at 57° to 58°) by means of ammonic sulphide, either cold or in sealed tubes at 100°, or by means of alcoholic potash, proved fruitless, although Schmitt and Moehlau[28] in a foot note to a paper on chlorphenols, state that they obtained amido and parazophenetol by the action of alcoholic potash.

Azoxyphenetol and azophenetol were made from the orthonitrophenetol by the last named investigators[29] by reduction with sodium amalgam. The former forms rhombic crystals melting at 102° and solidifying again at 83°. Orthazophenetol melts at 131°, boils at 240°, is soluble in concentrated hydrochloric acid, by which it may be separated from the azoxy compound. Hydrazophenetol, melting at 89°, was made by reducing the nitrophenetol with ammonic sulphide. They failed to obtain either the azoxyphenetol or hydrazophenetol from the para body.

Orthodiamidodiphenetol is the name given by Moehlau[30] to the base resulting from the transformation of orthohydrazophenetol under the influence of acids. He assigns to it the formula $(C_6H_3)_2(OC_2H_5)_2(NH_2)_2$. It crystallizes in needles or colorless plates, melting at 117°. It is nearly insoluble in cold water, soluble in ether, alcohol, and chloroform. It oxidizes very readily.

The bromo-amido compounds have been chiefly investigated by Staedel,[24] although one of these, the parabromo-orthoamidophenetol, was made by Stebbins in 1881 by reducing the bromonitro compound, prepared by the author's method above described.

Staedel gives the following properties of the amido bodies or *phenetidines*:

Bromoorthophenetidine, flat needles melting at 57°.

Dibromorthophenetidine, quadratic crystals melting at 92°.

Bromoparaphenetidine is an oil.

Dibromparaphenetidine, needles which melt at 67°.

The above are believed to be the only compounds or derivatives of phenetol (also called phenetoil) that have been described up to the year 1883.

In conclusion, I would call attention to the ease with which bromo and chloro nitrophenetol may be prepared as contrasted with the difficulty of obtaining nitro compounds directly; no tar, no waste, and no by-products. Since the former are quite as easily reduced as the latter, and also convertible into diazo and azo compounds, it is not improbable that they would come into use for making dyes if a cheap source of phenetol could be discovered.

New York, August 27, 1883.

ROUND SHOULDERS, OR ANTERO-POSTERIOR CURVATURE OF THE SPINE.

By CHAS F. STILLMAN, M.S., M.D., New York.

"ROUND shoulders" is one of the most prevalent deformities, and yet very little attention is paid by surgeons to its treatment, although it is amenable to curative measures with as little discomfort as any other prominent deformity.

An inquiry into its anatomical and physiological characteristics affords a clew to the treatment, that being the portion of the subject which more directly concerns us in this paper.

The spine, viewing it from the side, is a column composed of twenty-four segments, upon which rests the head, and to this column in its dorsal region is also attached the thorax, and secondarily the upper extremities. The normal line of the spine is a compound curve, and it is retained in this shape by muscles disposed along its course, acting as do the stays to a mast, and opposing the effect of the weight of the head as a constant gravital force to increase the curves. When the normal degree of tonicity does not exist in these muscles, this increase in the curves is found and is further exaggerated in the region of the neck and shoulders by the tendency of the upper extremities and thorax forward, and by this forward tendency we obtain the contracted chest, the separated and protruded shoulder-blades, and the bent and stooping shoulders, all characteristic of the deformity in this region.

But as the line of direction must be maintained, when the head drops forward the lower part of the trunk also projects itself, giving rise to the appearance of flat nates, and causing it to appear as if the dorsal region projected very much backward beyond the normal line, as in Fig. 1.

The most common cause to which this deformity can be ascribed is muscular weakness, the inability of the back to recover the erect position after it has been relaxed. Relaxation of the back is the position of rest assumed by the trunk when the superincumbent weight is to be more fully borne upon the bodies of the vertebræ, and we then rely upon the ligamentous bands and attachments rather than muscular force to keep the body in this less fatiguing position; thus relieving the muscles from all necessity of the contraction which is required if the trunk be maintained erectly. In this position of rest the spine curves backward in the shape of a bow, from the sacrum to the head, the center of the bow being in the middle dorsal region, the bodies of the vertebræ being crowded together throughout the whole extent of the spine (see Fig. 3), and the muscles not exerting their contractile force.

When the erect position is again assumed, the muscles should restore the normal spinal curves so that the head and upper portion of the trunk, with their appendages, become supported in the proper line of direction (Fig. 2).

But if the muscles lack tone or are fatigued, or the patient is indolent, the position of rest becomes habitual, and we have the production of round shoulders as the result.

There are various degrees and forms of the deformity, dependent upon the age of the patient, the length of the spine, the regional muscular development, the sitting habits, etc.; but these are sufficiently known to every practitioner not to require description here. The projection forward of the head and nates is not found to the same extent in every case, but seems to be compensatory—to permit the line of direction to be passed somewhat anteriorly to its normal position, in order that the body may be properly balanced while in the vertical position.

The *treatment* which concerns us most directly in this paper may be considered under two heads—*mechanical* and *physical*.

The *mechanical treatment* consists in the use of properly devised apparatus for the restoration and retention of the normal curvature, and the mechanical problem this involves resolves itself into the reduction of the dorsal curve, since the cervical and lumbar are merely compensatory and will tend to regulate themselves.

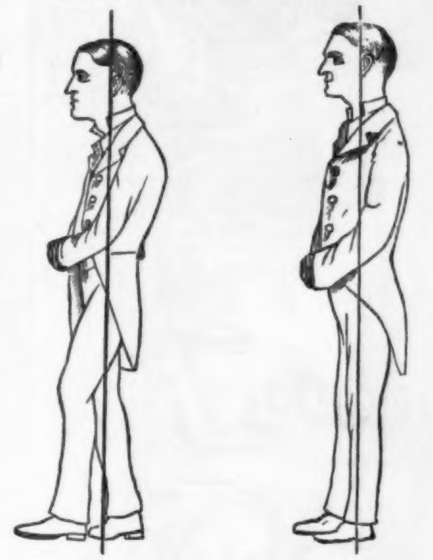


Fig. 1. Fig. 2.

We have already noted the fact that the exaggeration of the curves of the spine produces undue pressure upon the bodies of the vertebræ in the dorsal region, and we must therefore turn our attention first to placing the spine in such position as will tend to separate the bodies and transfer pressure to the other surfaces of contact in the normal degree. To effect this we utilize the principle of gravity as an extending force. When the patient assumes the horizontal position upon a table so arranged as to have its padded edge under the shoulder-blades, as in Fig. 3, and then allows the head and upper extremity to gradually fall backward and downward, we have produced a series of curvatures exactly opposed to those exhibited by the round shoulders. You will observe, as the patient's head and shoulders descend, a gradual obliteration of the condition of round shoulders and a reproduction of the normal curves of the spine. The bodies of the vertebræ become freed from the crowding to which they have been subjected, and a physiological and true extension of the parts is effected—the traction-force being the superincumbent weight, the cervical spine being placed in a state of extension by the weight of the head, and the dorsal spine in extension by the weight of the head, the neck, and the upper extremities. This combined weight, augmented by gravity, is simply tremendous as a traction or tractive force, and produces a true backward physiological *extension*. Do not confuse the words traction and extension, or substitute one for the other. Traction is the force which produces extension. The former is a cause, the latter an effect; the former is an active agent, the latter is a condition; or in other words, extension is a result of traction and is the effect produced upon a joint by traction. The words are not synonymous, and should not be so employed. This principle of backward traction, by the weight of the upper extremities, is one which we have been utilizing lately, as a most satisfactory factor for the production of extension in Pott's disease, as we not only obtain as much extension of the spine as we can by suspension (or traction by the lower extremity), but we obtain this in a backward direction, which enables us to apply leverage to obliterate the deformity to a more satisfactory extent than ever before, and with less discomfort to our patients.

We have now, by the use of the table, obtained great improvement in the condition of the deformity, and the question arises, how are we to retain this improvement when the vertical position is again assumed, as the posterior spinal muscles are impaired and have not sufficient power to hold the spine in its restored curves?

Although in slight or recent cases this can be accomplished by simple methods, yet a brace will often be a necessity in severe cases, and it is easy for us to construct one upon the principles which govern the reduction of the deformity.

We must strive to keep the patient in a state of hyper-erectness until the muscles have contracted and been exercised and invigorated sufficiently to render the use of a brace unnecessary; and if we glance at Fig. 3, and turn it in such manner that the supine figure will appear vertical, it will be seen that the figure is more erect than normal, *i. e.*, hyper-erect, and this position (of the dorsal, not the cervical spine) is necessary to the development of the impaired muscles as well as for its effects upon the spine itself.

Now, how to keep this position with a brace. It may be to some extent done with a strong back-frame, fashioned to the hyper-erect shape and put in position and secured while the patient lies upon the table in the extension position. This frame may be made of some metal which can be bent by the hands of the surgeon, but it must necessarily be made of such heavy material as to be too cumbersome for general use, for it must be sufficiently firm to withstand the tendencies of the deformity, as it matches strength of material against the tendency of the superincumbent weight to fall forward.

I must impress upon you the importance of having this frame fashioned to the hyper-erect shape, for if so made, and well secured to the body, the forward tendency of the body and the exaggeration of the dorsal curve are to some extent prevented by the strength of material and shape of the splint.

[Figures of braces are here given, which we omit.]

The *physical* treatment next engages our attention, and by this we mean the employment of such exercises and movements during the mechanical treatment as will conduce to the permanent cure of the deformity after the braces and corsets are thrown aside.

It is necessary in the first place to have a table, although a lounge or couch could be made to answer, the surface of which is padded or so covered as to be comfortable to the patient. This table should be a low one, so as to divest the patient of all fears of falling while undergoing treatment, and on such a table when the patient places himself there in the extension position—the edge of the table coming to the central dorsal region, and the head and upper extremities hanging over—you will see that the chest has partially resumed its normal shape, that it has lost its contracted look, and that the shoulder-blades tend to approach each other. To approximate these it is necessary to clasp the hands together behind and under him—and at first this is almost an impossibility. When undergoing this process it would appear as if the skin and tissues of the anterior of the thorax were stretched as much as their structure would allow, and that posteriorly the soft parts were redundant.

Dumb-bells of various weights are now taken in the hands and a series of rapid lateral movements practiced which still further expand the chest. There are also quite a number of calisthenic exercises which are of advantage if practiced in the backward traction position, but they must be employed with care and moderation, as their expanding effects are so powerfully augmented by gravity that they may strain the tissues painfully and thus delay treatment. A most useful agent is also found in the rubber cord. Of these there should by two, fastened by detached hooks and staples to the floor in such a manner as to draw the hands beyond each other, the resistance of the muscles to the contractility of the rubber constituting a most valuable agent for developing the chest if formulated into a series of exercises.

This backward traction position may seem harsh exercise to be daily indulged in by your patients, but it is the most efficacious plan of physical treatment, and will do the most good in the shortest time. There are, however, many lighter forms of exercise which may be utilized.

One which can be specially recommended for other than the backward traction position is one in which the chest is expanded by the body falling forward as much as the rubber cords grasped by the hands will allow, the feet not being moved and the head prevented from falling forward with the rest of the body (and thus the hyper-erect position maintained) by means of a wooden bar placed between the teeth and connected to a gymnastic frame by cord or wire. This is very serviceable also, in strengthening the muscles of the neck.

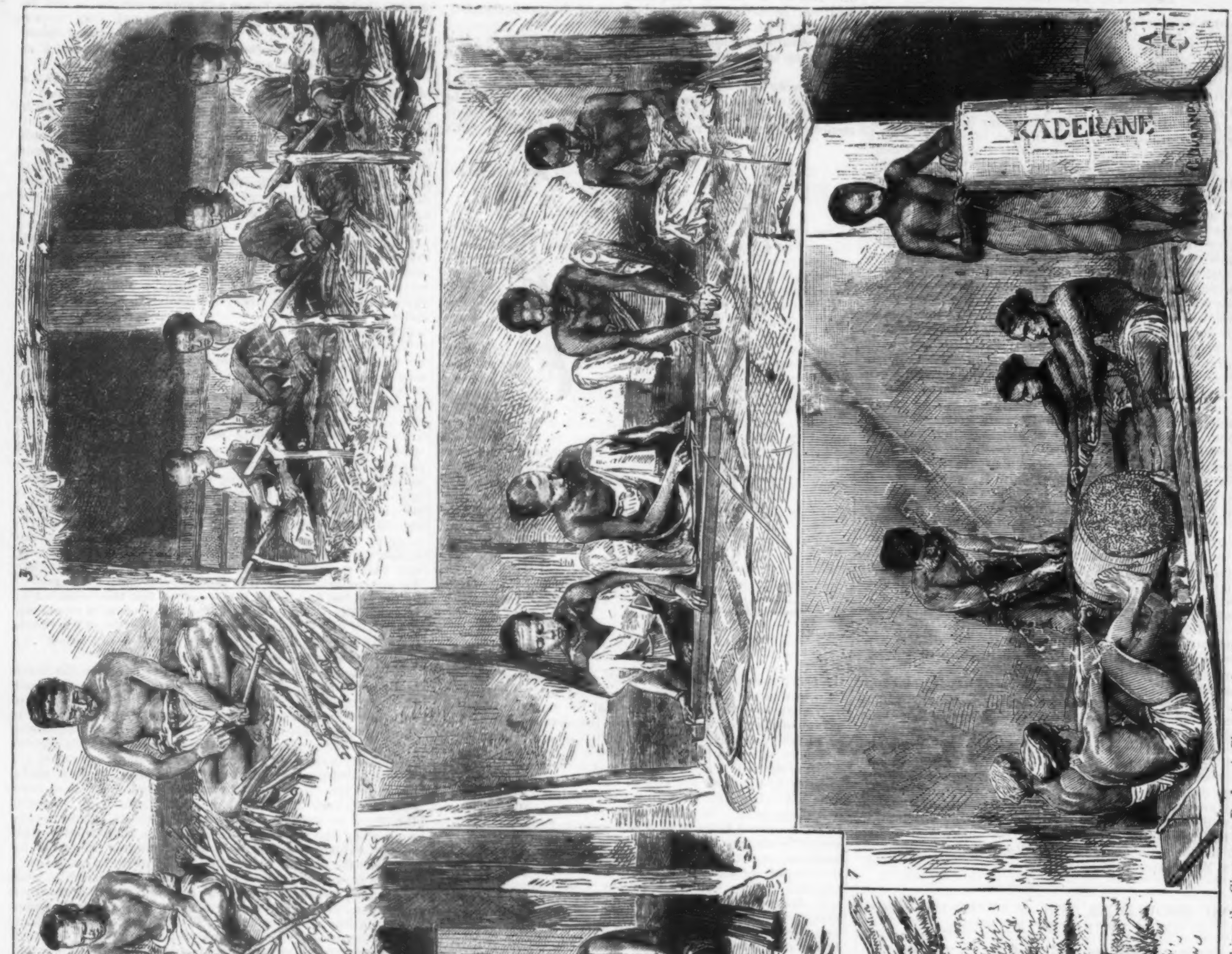
Fig. 3.

There are also certain postures which are of themselves beneficial, and should be recommended to your patients for their adoption.

The *first* is in regard to sleeping. Have both bolster and pillow removed from their usual place under the head, and have one or both placed under the shoulder-blades. This brings the head a little below the level of the dorsal region and curves the spine in direct reversal to the curves of the round shoulders; and as, during sleep, relaxation of the spine ensues, the posterior spinal muscles are permitted to recover some of the contractility they lose during the day if proper supports be not worn.

The *second* is that of reclining (not upon the back but upon the front of the body) during the day for reading or resting, the patient lying at full length, and resting on the elbows. This is a favorite position with children and should be encouraged, as, if steadily practiced, it is a sure preventive of the deformity. But many parents, instead of en-

[26] Zeitsch. Chem., xii, 450.
[27] Ann. Ch. Pharm., clvii, 156.
[28] J. pr. Chem. [2]., viii, 1.
[29] " " " [2]., xviii, 198.
[30] " " " [2]., xix, 381.



1. Cutting Cinnamon Sticks.—2. Peeling the Sticks.—3. Stretching the Cinnamon on Boards.—4. Cleaning the Cinnamon on Boards.—5. Cutting the Cinnamon into Lengths.
6. A Cinnamon Drying Ground.—7. Tying the Cinnamon into Bundles for Exportation.

THE PREPARATION OF CINNAMON IN CEYLON.

couraging this trait, rebuke their children for it, and sharply order them to get up from the floor. If they could only be made to understand that it is one of the greatest helps to symmetrical development, they would be more inclined to encourage its practice.—*Medical Record.*

CINNAMON CULTURE IN CEYLON.

"ABOUT 1770 De Koke conceived the happy idea, in opposition to the universal prejudice in favor of wild-growing cinnamon, of attempting the cultivation of the tree in Ceylon. This project was carried out under Governors Falck and Vander Graff with extraordinary success, so that the Dutch were able, independently of the kingdom of Kandy, to furnish about 400,000 pounds of cinnamon annually, thereby supplying the entire European demand. In fact, they completely ruled the trade, and would even burn the cinnamon in Holland lest its unusual abundance should reduce the price."

So determined were the Dutch to retain the monopoly in the produce of cinnamon that the plants were limited to a certain number, and all above that number destroyed, besides which large quantities of cinnamon, after having been prepared for market, were frequently thrown into the sea or burnt. It is recorded that on the 10th of June, 1760, an enormous quantity of cinnamon was wantonly destroyed near the Admiralty at Amsterdam. It was "valued at eight millions of livres, and an equal quantity was burnt on the ensuing day. The air was perfumed with this incense; the essential oils, freed from their confinement, distilled over, mixing in one spicy stream, which flowed at the feet of the spectators, but no person was suffered to collect any of this, nor on pain of heavy punishment to rescue the smallest quantity of the spice from the wasting element."

When Ceylon came into the hands of the English in 1796 the cinnamon trade became a monopoly of the English East India Company, and it was not till 1833 that this monopoly was finally abolished, and the cinnamon trade passed into the hands of merchants and private cultivators.

A very heavy duty to the extent of a third or half its value was imposed upon cinnamon up to within so recent a date as 1853. At the present time by far the largest proportion, as well as the finest quality, is obtained from Ceylon, where extensive plantations exist.

The cinnamon tree, which is very variable in form and size, is known to botanists as *Cinnamomum zeylanicum.* It is very generally distributed in the Ceylon forests up to an elevation of from 3,000 to 7,000 feet. The best quality bark is obtained from a particular variety, or cultivated form, bearing large irregular leaves. The barks, however, of all the forms are very similar in appearance, and have the same characteristic odor, so that it is sometimes impossible to distinguish the best trees from appearance alone. It is not uncommon, indeed, for the cinnamon peelers when collecting bark from uncultivated plants to taste a small portion before commencing operations, and to pass over some trees as unfit for their purpose. On the southwest coast of Ceylon, on a strip of country some twelve to fifteen miles broad, between Negumbo, Colombo, and Matura, the best quality of cinnamon is found up to an elevation of 1,500 feet.

Sir Emerson Tennent states that the five principal gardens in the above district were each from fifteen to twenty miles in circumference. Owing, however, to the enormous extent of coffee cultivation, up to within the last few years many of the cinnamon gardens have given place to coffee, which has since been so seriously devastated by the *Hemileia vastatrix* that coffee-planting has in many plantations been itself abandoned.

The management of the cinnamon plantations has been described as similar to that of oak coppice in this country. The plants are pruned to prevent their becoming trees, so that several shoots spring up, four or five of which are allowed to grow for a year or two. At this period the grayish green bark begins to change color, and to assume a brownish tint. As the shoots arrive at the proper state of maturity, at which time they are usually from six to ten feet high, and from half an inch to two inches thick, they are cut down with a long handled hatchet-shaped knife, known as a *catty,* as shown in Fig. 1. The leaves are then stripped off, and the bark slightly trimmed of irregularities, the trimmings being sold as cinnamon chips. It is next cut through at distances of about a foot, and cut down also longitudinally; it is then very easily removed by inserting a small sickle-shaped knife called a *mama* between the bark and the wood.

After removal the pieces of bark are carefully put one into another and tied together in bundles. In this state they are left for twenty-four hours, or longer, a kind of fermentation taking place which helps the removal of the outer bark. To effect this each piece of the bark is separately placed on a stick of wood convex on one side, and by carefully scraping with a knife the outer and middle layers are removed. At the expiration of a few hours the smaller quills are placed within the larger, and the bark curling round forms a sort of solid stick, generally about forty inches long. These sticks are kept for a day in the shade to dry, and then placed on wicker trays for final drying in the sun, as shown in Fig. 6, and when thoroughly dried are made into bundles, each weighing about thirty pounds (Fig. 7).

Notwithstanding that the cinnamon plant has been introduced into India, Java, China, Senegal, Brazil, West Indies, and other parts of the world, the bark imported from these places is deficient in aromatic qualities, and Ceylon cinnamon still holds its own as the very best quality brought into the market.

The quantity of cinnamon imported into this country in 1881 amounted to 1,736,415 lb. of the value of 121,176*l*. The chief use of cinnamon is as a spice, but it is also largely used in medicine as a cordial and stimulant.

Our engravings have been made from photographs taken by Messrs. W. L. H. Skeen & Co., of Colombo, which have been recently acquired for the Museum of Economic Botany at Kew, and we are indebted to Sir Joseph Hooker for the loan of them.—*London Graphic.*

WHITE LILY OF THE INCAS.

(*Alstrœmeria pelegrina alba.*)

THE value of Alstrœmerias in the garden is well known to those who have good collections of hardy plants, but it is surprising to find how comparatively little grown is A. aurantiaca, which, without question, is among the very finest hardy flowers that now enrich our gardens. It is undoubtedly the best of the Alstrœmerias for general cultivation, but we should like to direct attention to another fine species whose beauty is of another character. This plant is A. pelegrina, or the Lily of the Incas, as it is popularly called, which inhabits Chili and Peru. The flowers of this species are larger than those of the other cultivated kinds, as may be seen by the accompanying woodcut, which represents the white form of it, and they vary a good deal in color from a deep flesh tint to a pure white, the latter being extremely beautiful. It is one of the dwarf growers and not at all difficult to cultivate, according to Mr. Kingsmill, who grows it well, and from a plant in whose garden at Eastcott our illustration was prepared. Concerning the culture of it, Mr. Kingsmill, who grows it admirably in pots, writes: "The culture of this plant is of the simplest. Sandy loam seems to suit it well. The pot should be very well drained, as, like all Alstrœmerias, any disturbance of the root growth must be avoided, and the plant seems to thrive best when let alone, or repotted only every third year or so. After the growth has all died down the plant will do best if kept fairly dry in a frame from which frost is excluded. Heat must be avoided, as it leads only to a premature and weak growth; in fact, the lights are best off altogether after growth commences and frosts are over. This Alstrœmeria has the additional advantage of being very dwarf, rarely exceeding 8 inches to 10 inches in height. Fresh seed germinates very quickly, and with care might flower the second year from time of sowing." Other excellent Alstrœmerias worthy of culture are the varieties of A. pulchella, ligtu, and hæmantha, all of which require much the same treatment as A. pelegrina. A. aurantiaca is a strong grower in good light soils, and requires no attention whatever, save that of keeping it within bounds. —*The Garden.*

WHITE LILY OF THE INCAS (*Alstrœmeria pelegrina alba*). Drawn at Eastcott, Pinner, in June last.

ESCHSCHOLTZIAS.

ONE of the latest and most beautiful additions to these favorite Californian annuals is one called Rose Cardinal, a sport from the lovely Mandarin, which has flowers as large as the ordinary *E. californica,* but yellow within, and of a rich reddish orange on the exterior. Rose Cardinal has flowers somewhat smaller, but of a soft, clear, rosy tint, as delicate in tone as any flower in gardens, and, like Mandarin, the petals are overlaid with a satiny luster that adds so much to the beauty of the flower. These two eschscholtzias are among the loveliest of all flowers, and the sight of large breadths of them may be better imagined than described. Besides these, there is the double-flowered *E. crocea,* of a bright orange color; also a white variety of it. The old original *E. californica* is still a beautiful plant, but all must pale before the Rose Cardinal and Mandarin, which ought to be seen in all good gardens.—*The Garden.*

ESCHSCHOLTZIA MANDARIN.

MASDEVALLIA CARDERI.

THE accompanying illustration represents a plant of the new Masdevallia carderi, exhibited this season at one of the meetings of the Floral Committee. The introduction of the species is due to Mr. E. Shuttleworth, and it was described in our columns by Professor Reichenbach so recently as June 23 last. The substance of the flower is described as being singularly fleshy and soft; the long tails yellow, spot-

MASDEVALLIA CARDERI.

ted with dark, blackish-purple; and the free, triangular portions as being short, and the short cupula whitish outside, ocher-orange at the base, and bearing a blackish, mauve-purple zone between these two areas. It is a species that all lovers of this singular genus will look forward to possessing.—*Gardener's Chronicle.*

WAYS OF LEMMINGS.

By Dr. G. A. STOCKWELL.

OF all the rodent or gnawing tribes, none—the beavers perhaps excepted—are popularly invested with so many and foolish attributes or have excited more universal curiosity and discussion than the lemming rats. From the earliest days, these simple and inoffensive little creatures have been made the prolific theme of idle fancies and superstitious tales, until their history as commonly accepted is but a mass of incongruities by which they are endowed with extraordinary endurance and tenacity of life, unbounded rapacity, unheard of cruelty, feats of strength and legerdemain impossible, and habits generally both flagrant and vagrant. Even so late as 1879 the old fables of centuries ago were dragged into light, remodeled, and made to do duty as original productions; while still more recently travelers whose writings have obtained a widespread popularity—presumably owing to their skill with the "long bow"—have published the inconsistent and exploded vagaries of Regnaud as theories derived from personal observation. Indeed, it would seem almost as much an impossibility for the average tourist to visit Scandinavia without writing upon the lemming, as for the rural schoolboy to forego the temptations of a convenient trout stream while hook and line rest handily in his pocket; regardless, too, of the fact that the species is unknown, save in a few isolated localities, within the boundaries of civilization.

The lemming is more or less common throughout the greater portion of the sub-polar region, and is perhaps most abundant in the "Barren Grounds"—that great waste of British America of which Melville Peninsula is the extreme northeast portion; but here it is divested of all romance, and of those traits, none the less charming because untrue, that have become attached to its Old World cousins, for which we may thank the plain, practical, matter-of-fact evidence of Samuel Hearne, who possessed as much hatred for the fabulous as his Plutonic Majesty is supposed to evince for holy water. Greenland possesses at most but a few individuals, and they are by no means marked characters in the fauna of Kamschatka and Alaska. They prevail, however, in New Siberia and the Lachov Islands, scamper over the tundras of Taimur Land, undermine with their burrows the mountain slopes of Nova Zembla and portions of Lapland, and are occasionally met with in Spitzbergen, Jan Mayen, and Iceland; and, doubtless, when the Pole shall be reached, they will there be found disporting themselves among the sparse vegetation, there sheltered by southern slopes, and nourished by refraction from the rocks of solar heat.

They are pretty little creatures, clothed in fine soft furry coats of variegated brown and yellow; are not above five inches in length; have a pointed head, something like that of a pika hare or Guinea pig, which terminates in a small mouth with cleft and tremulous upper lip; short, prettily rounded ears, reclined backward, and so minute as to be almost concealed by the surrounding fur; a short, stubby tail, not an inch long; and four somewhat abbreviated legs, the fore ones the shortest and with but four claws on each foot, the place of the fifth being supplied by a rudimentary process or tubercle very like the spur of a gamecock—the hinder ones longer, heavier, and with a full complement of digits; and all the feet armed with stout claws and padded and protected on their under surface by coarse matting of hair. Naturally they are mild and timid in disposition, and simple in habits, demanding but little to sustain life, and that little the most primitive forms of vegetation. In their native haunts, their chief sustenance is weeds, mosses, lichens, and grasses, with now and then perhaps a stray spider, beetle, caterpillar, or butterfly. They love the buds or catkins of the "pussy" willow and birch, and though not naturally climbers, manage to ascend the smaller and more branched of these growths to feed thereon. Largely nocturnal in habit, they are rarely seen during the middle of the day, their favorite hour for feeding being the long twilight of the Arctic night, when the partial gloom offers greater freedom and security from manifold enemies; while the day is passed in hiding, perhaps curled up in sleep, in some of the many passages or burrows each one hollows out for itself beneath the rocks and in the earthy slopes of hills and gentle ascents. In winter they do not come out in the open at all, when it can possibly be avoided. Instead they move about beneath the snow and close to the ground by means of passages there excavated leading to the roots of grasses and weeds which they affect as food; and as the supply is exhausted they are obliged to go further and further away from their burrows, until just before the break-up in the spring they have undermined "earth's white mantle" in every direction, the passages or runways crossing and recrossing each other in labyrinthine mazes. This winter habit is also a wise provision of nature, since the lemming is one of the few animals of the extreme North that does not change the color of its coat in winter; and were it otherwise, their dark bodies reflected against the pure white of the snowy waste would but insure their capture by numerous predatory animals and birds, who, as it is, secure a goodly share.

As a rule, lemmings take kindly to captivity, seeming to possess the rare faculty of at once adapting themselves to surroundings. Even adults will after a few days' confinement feed from out their captor's hands, and soon are so thoroughly domesticated as to court the utmost familiarity, when on account of their excessively cleanly ways and habits they prove most interesting and even affectionate pets. They delight, apparently, in caresses and in being handled, climb fearlessly over and about one's body and clothes, now nestling in his neck, then in his bosom or beneath his coat, and exercise their curiosity by peering into and exploring his pockets. Two or more together will romp with all the frolicsomeness of young kittens, and are almost untiring in their play; and when resting, they betake themselves to their food, or to some warm corner, where they sit and comb and dress their furry coats by the half hour, going over again and again until it fairly shines in glossiness. A box of firmly sodded earth with strong growing grass is their delight, and it is burrowed into for the purpose of feeding upon the roots and sprouting tendrils which they nip off with their sharp incisor teeth just below the surface.

The female is a very motherly little creature, and under favorable circumstances rears several litters of little ones each year. One passage of the burrow she inhabits, usually the most remote, leads into a small den or chamber which, comfortably lined with fine soft and dry grasses, mosses, and shreds of fur from her own body, constitutes the lying-in room and nursery. Here the infantile lemmings are ushered into the world, and here guarded and cared for until sufficiently developed to in a measure look out for themselves; and more helpless little things when first born, in their naked and blind state with overgrown heads, protuberant eye-lids, thick lips, almost microscopical ears, and slender bow legs, cannot well be imagined. Should, however, any unforeseen circumstance force the parent to abandon her dwelling, she hoists her immature family on her back, where they cling pertinaciously by means of their little claws, and perhaps with an odd one in her mouth as a cat carries its kittens, she takes up her march in search of new quarters. Now, too, if interrupted, she will do battle bravely, for once belying her naturally timid and retiring nature. The younglings, usually five or six in number, mature with astonishing celerity. Before many hours old the fur begins to exhibit itself on the pale pink skin, and before the end of the week is well grown. The third day the eyes are opened, and the legs assume their offices; and ere a month or at most five weeks have elapsed, they are supposed to have arrived at an age of discretion, and are turned out in the world to work out the problem of life for themselves.

Occasionally, though such are of exceptional and extremely rare occurrence, lemmings multiply to such an extent that the locality or district inhabited is no longer able to supply the demands of hunger, and the result is a migration of the entire community or communities, who, leaving their homes suddenly, usually at night, move away in search of more fertile pastures. As these movements take place for the most part between twilight and sunrise, are confined chiefly to regions beyond the pale of civilization, and the animals are wont in general to lie up in hiding during the middle of the day, few are ever fortunate enough to witness one. But in a Norwegian agricultural district, the few acres held under cultivation by the average farmer (an area that in America would scarce be permitted to do duty as a vegetable garden), and from whose sterile soil the scanty crops are absolutely wrested by ceaseless toil and energy, and even then are oftentimes insufficient to make two ends meet, the sudden irruption of half a dozen scores of starving lemmings would be a matter of considerable import; and undoubtedly the grass, grain, and hay, whether on the ground or in the stack, would suffer quite seriously ere they passed beyond the boundaries. Such is the true migration of the species, which elsewhere than in sterile, superstitious, and overpopulated Norway would scarce be considered worthy of remark, much less looked upon as a special punishment and manifestation of Divine wrath; and such, too, is the slender origin of the marvelous, not to say scandalous, tales, that from the days of Olaus Magnus and Pontoppidian down to the present pervade our literature regarding these creatures and obtain credence in the minds of all save a few practical and scientific men, who seeing the falsity of the arguments upon their face, reasoned out the truth by analogy and personal visits to the regions where the scenes were laid. Space will not permit the relation of the half of these marvels; but the more common ones were briefly something as follows:

First, that the migrations occurred regularly every tenth year and during stated months, commonly in early autumn, when the animals suddenly spread over the face of the country in such overwhelming multitudes as to lead the peasantry to believe they sprang from the bowels of the earth or tumbled from the sky; their numbers covering scores upon scores of leagues in every direction, and so thickly that the ground was covered as if with the leaves of the forests, making it impossible for any living thing to move without crushing them with every step; and all moving in one direction (east to west, or, this not affording scope enough for some of the precious Munchausens, from northeast to southwest), allowing nothing to check their progress, which continued unceasingly day and night for *many weeks;* they ate their way through hay ricks, gnawed through houses, scaled stone dwellings, trees, cliffs, and even the bodies of human beings they might encounter, merely for the privilege of descending upon the opposite side; wells and streams were choked up, and fires smothered by their bodies, over which their companions passed, never swerving a hair's breadth to the right or left of the line of march—which was ever as the crow flies—for any obstacle, but ever going over or beneath it. Second, that they moved with military precision, led by captains of tens, of hundreds, and of thousands, which officers could be seen moving hither and thither, apparently giving orders, or hovering about the flanks to bring up stragglers and direct the line of march; and then the host passed on, leaving devastation and disease, poverty and pestilence, in its rear, until at last all disappeared at the sea shore, where they either emulated the famous drove of swine in Scripture by casting themselves into the waves, or dividing into two armies equal in numbers and strength, originated a battle which in results and ferocity has never been equaled since the squabble of the Kilkenny cats, and like that tournament, "not one was left." Really, the frogs of Egypt were a joke to these! And more modern authors, jealous of the laurels won by their predecessors, have added thereto, and filled the cup of superstition to the brim by such fancies as those of Regnaud—but let him tell the story his own way:

"When it is necessary to pass some lake or river, as happens at almost every step in Lapland, these little animals take the bark of a pine or birch tree, which they drag to the brink of the water, then set themselves upon it, erecting their tails over their backs like sails, and abandon themselves to the mercy of the wind, which, becoming stronger, overturns both the ship and the pilot. This shipwreck which often overwhelms 3,000 or 4,000 vessels, generally brings an extraordinary influx of wealth to those Laplanders who find the remains on the shore, and who, if the little animals have not been too long on the sand, make use of them for food. Many of these animals make a successful voyage, and arrive safe in harbor, provided the wind be favorable, and not strong enough to raise any waves, which need not be violent in order to engulf these little craft. *This singular performance might be considered a fable if I had not witnessed it myself."*

Imagine for instance any animal smaller than a porcupine, and a non-climbing one at that, removing the bark of a birch—to say nothing of a pine—tree, or dragging a piece of size sufficient to bear its weight in the water; and when this is duly digested, think upon a creature which, while sitting at rest, assumes the attitude of a Guinea pig or rabbit, with its haunches and hind legs well drawn up under its body, elevating a tail less than an inch long over a back two inches high! Even if "*I had witnessed myself,*" I opine there would be something incongruous in the act. And if other evidence is needed of the character of all these tales, that of the celebrated German naturalist, Christian Ludwig Brehm, is all sufficient, since he visited the haunts of the lemming for the express purpose of studying their habits; and in Dovrefjeld, the province of Norway where they most abound, he could find no one even among the oldest inhabitants who had ever heard of such occurrences, and his inquiries in Finland and Lapland were equally fruitless.

Under all ordinary circumstances, the inclemencies of climate and number of enemies are sufficient to keep the lemmings in check. A wet summer, or an early, cold, and snowless winter destroy them by millions. The wolf, fox, wolverine, marten, and ermine devour as many more; while a good lemming year is a time of unusual plenty for Lappish, Samojede, Tchuktchi, and Esquimau dogs. The snowy owl whose dense plumage enables it to be a constant resident of the coldest latitudes, frequents almost exclusively those regions where the lemmings, their favorite food, are to be found, and seems to possess the power of detecting them even beneath the snow. Hawks and buzzards are constantly active in their destruction; the crow feeds her young with them; and even the half-civilized Lapp and Samojede, when pinched by hunger, seizes a stick and goes lemming hunting, rejoicing when he has secured enough for his dinner. Stranger than all, the reindeer exhibits a peculiar but well authenticated taste, in that it devours these little creatures—a taste doubtless developed in time of hunger, and like most newly acquired and depraved appetites, not easily forgotten.

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